THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893,

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THE MAINTENANCE OF SELF-CONTAINED CARS.

IT is impossible to avoid frequent references to electric locomotion, and particularly to the method of accumulator traction, which is regarded as the ideal for urban traffic. We mentioned some time ago that an electrical company had expressed its willingness to undertake the maintenance of storage batteries for use on tramcars at the rate of one penny per car mile run, a figure which has hitherto been very attractive, but misleading. It was, however, understood that this referred to a large service of cars—of, say, fifty. This number somewhat depreciated the value of the up-keep at one penny, since it would be a very bold tramway company which would make a large experiment of this nature, apart from the possibility of raising the necessary capital. As a consequence, the proposal was never seriously entertained; and now the same company, the Electrical Power Storage Company, has suggested an alternative scheme in a circular letter which has been addressed to the principal tramway companies in Great Britain. The circular states that the company is "now prepared to negotiate for the working and maintenance of approved tramlines equipped with self-contained or storage electric cars. The terms under which such working and maintenance can be contracted for necessarily vary with local conditions, but the maximum charge would be 66 per cent. of the gross traffic receipts." This is considered by the company to be "the most effectual guarantee of perfection of service." Of course, everything depends upon what is implied by an "approved" tramline. It may be a length of three miles on a level served by, say, ten cars; it may be a longer line with inclines served by comparatively few cars; it may be a line in a thickly populated district with a large number of cars in service; or it may refer to another type of line. We find, however, that the manager of the company would not operate any line where there are less than ten cars in constant service, and that if 34 per cent. of the gross receipts were not sufficient to maintain the permanent way and provide the general secretarial office expenses of a tramway company, the E.P.S. Company would not consider such a company worth its attention; and that the electrical company would not furnish the capital for the initial purchase of the batteries.

We are afraid that this statement will not tend to enhance the adoption of storage battery cars in this country, although, if properly understood, it should have that effect, notwithstanding that in no single case in England has it been demonstrated by practical working results that self-contained cars can be operated, and the batteries, gearing, and the plant at the depôt, maintained for less than from 8d. to 9d. per car mile. At Barking, the few cars which were in service were stated to have cost about 8½d. per car mile run.

On the other hand, with about a dozen cars in use at Birmingham, the gross receipts during the last financial year amounted to 15·15d. per car mile, and the expenses to 9·90d. The latter being assumed as correct, the former may likewise be taken for granted. How, then, it might be asked, can the Electrical Power Storage Company hope to secure any return on the basis of having at most 66 per cent. of the gross receipts? This will be better understood by reference to the following table giving the names of companies, the receipts per mile run, and the share which, according to the 66 per cent. basis, would fall to the contracting company. The figures refer to 1889, but they are all the more valuable, as since then tramway companies generally have not been earning more money per mile, but rather, if anything, less :—

Name.	Receipts per mile run.	66 per cent. of receipts.
London Tramways	10·52d.	7d.
North Metropolitan (1891-92)	13·52d.	9d.
Glasgow Tramways	12·34d.	8d.
South London	10·06d.	6⅝d.
Croydon Tramways	9·13d.	6d.
Birmingham Tramways ...	11·02d.	7¼d.
Belfast „ ...	10·70d.	7d.
Dublin „ ...	11·85d.	7¾d.
Liverpool „ ...	11·69d.	7¾d.

The figures given above are the average receipts per mile run throughout the companies' horse car systems, which, in some cases, extend over long distances, with a very large number of horse cars in operation. In only one case, however, does the ratio of 66 per cent. approximately correspond with the figures given concerning the cost of running accumulator cars at Barking and Birmingham. One might be pardoned, therefore, for being unable to see at a casual glance how such undertakings could possibly prove remunerative to the intending contractors on that basis, as on the above showing, expenses would only barely be met in one single instance. But from information which has only quite recently been brought to our notice there seems to be scarcely any doubt that the batteries at Barking and Birmingham were ruined by working against obstacles such as they were never intended to overcome; in other words the state of the road in one place and the construction of the cars in the other were of such a nature that storage batteries had no real chance of proving their worth. Mr. Frank King ought to know as well as any man living how much may be expected from accumulator plates, and if he, as an engineer, endorses in his capacity as manager, the Electrical Power Storage Company's offer, we may rest assured that when properly used the cost per car mile will be considerably less than that in which the abnormal conditions existing at Barking and Birmingham have resulted. This is, however, apart from the important point mentioned at the recent meeting of the Tramways Institute by Mr. J. W. Carruthers-Wain, who said that the promoters of new inventions would find, as the tramway companies had found, that it was almost as difficult to obtain capital to buy them as it was to purchase tramways. This was, indeed, the consensus of opinion of the tramway men, who, being generally unable to spend money in such experiments, have left it to electrical engineers to bear the brunt of accumulator traction, and there the matter stands for the moment. However much the general use of self-contained cars is hoped for—and nobody is more anxious for such a consummation than we ourselves, because we think it feasible on the lines laid down by Mr. King—we can only conclude that tramway companies will wait until their prospects either become brighter, or until it is demonstrated by practical experience that a saving in working expenses over horse cars would be effected by those of the self-contained type, before making disbursements which they are now hardly in a position to undertake. Perhaps Mr. King would not object to ventilate this scheme still further from the battery point of view.

NOTES ON ELECTRIC LIGHT SYSTEMS.

Some time ago, electrical circles resounded to the noise of the battle between the advocates of direct current and of alternate current working, and when this battle was decided, it appeared likely, especially as a result of the Frankfort Exhibition, that a second battle was to be fought between the ordinary alternate current systems and the multiphase systems. The endeavour on the part of German copyists of Tesla's early two and three-phase work, to persuade visitors to the Frankfort Exhibition that the Drehstrom idea was "made in Germany," was only partially successful, thanks to the outspoken acknowledgment by Mr. C. E. Brown of his indebtedness (and, of course, that of his colleagues) in the Frankfort-Lauffen experiment, to Tesla.

It has been repeatedly pointed out that this experiment was far more a test of high tension working than of multiphase working, the latter, of course, being quite capable of full examination without any long-distance lines. The two questions of high tension possibilities and of multiphase working were, however, mixed up in the public mind in such a way that the success of the former has been supposed to include the success of the latter. As a matter of fact, the only reason for the employment of multiphase currents as against simple alternating currents, is the supposition that only by multiphase currents could self-starting alternate-current motors be worked. In the nature of things, this supposition was bound to be disapproved. For, on first principles, it follows that since all direct current generators and motors are essentially and in the first place alternate current generators and motors, there has, at any rate, always been a very strong probability of successful alternating current motors being ultimately developed. This is, perhaps, a scholastic way of putting the case, but we believe there is every chance of its being supported by practical achievement.

We are led to these observations by a study of a long and exhaustive report on the choice of a system for Frankfort-on-the-Main. The question has been examined by Oscar Von Müller and Mr. W. H. Lindley in their capacities as Consulting Engineers to the Corporation at Frankfort. In view of Von Müller's known care and caution, and great experience of all systems of working, whether direct current, alternate current or multiphase working, the conclusions arrived at in this report are of great importance. An exhaustive comparison is made of all the available systems, and the choice of the authors falls on the simple alternate current.

The two questions on which, perhaps, there is most diversity of opinion, are as to the use of arc lamps, and as to the employment of motors on alternate current circuits, and

it is interesting to find that the authors prefer the alternate current system even for these two. Of course on all the other grounds of ease of distribution, economy, flexibility of systems, and so on, practice has decided in favour of alternating currents, except for small condensed areas supplied from within; and it is significant that arcs and motors are now, in this authoritative way, added to the list of departments of electric distribution that may be quite successfully undertaken in the same way.

As regards arcs, the authors state that, as compared with direct currents, equal light is given under similar conditions; while for small consumers the alternate current system is more useful, as the E.M.F. can be transferred down to suit one arc lamp.

Regarding motors, they refer to recent experiments showing the possibility of building self-starting motors to work with the ordinary alternate currents, and state that this fact decides them to recommend simple, rather than multiphase currents, which latter, until recently, have had an advantage in respect of motors. The evidence is thus accumulating in favour of the simplest form of alternate current working for power transmission as for other purposes, although it seems reasonable to suppose that for power transmission from one point to another (as distinct from power distribution), there will remain some considerable field for the two-phase arrangement.

It is a very singular thing that, beyond a little theorising, English electricians have taken no part either in the inception, development, or practical application of the Drehstrom system. We think this is very largely due to a quiet belief that what was obviously not the simplest system could never hope to be more than a stop-gap. But if England can claim no credit in connection with this interesting branch of invention, we can at least put forward a claim as regards simple alternate current motors, for so long ago as 1868 Wilde described experiments which really involved motor action of alternators; in 1882 Hopkinson not only predicted from theoretical considerations, but proved by experiments that alternators would work as motors; and in 1889 Mordey recalled attention to the subject and showed that this was not merely an interesting scientific fact, but that for transmitting power over long distances simple alternate currents and simple alternators in reality offered the best and most practical of all modes of electrical transmission.

Storage Battery Traction.

The position of the self-contained car has been well recognised in America, and due importance has been given to its possibilities. An able article appeared on the subject in the New York *Electrical Engineer* some time ago, and another has just been contributed by Mr. G. Herbert Condict. This gentleman has very properly condemned in no measured terms the rash statements made by interested parties, as to the cost of traction by accumulator cars, the figures on which the estimates are based being admittedly taken from a few trial runs made at intervals, and in no sense the result of working on a really commercial scale. We agree with his remarks in the main. There are undoubtedly "batteries and batteries," and some think that the battery to make self-contained tramcars a practical success belongs to the future, although, as mentioned elsewhere, the E.P.S. Company state their willingness to contract to run tram lines of not less than 10 cars on a basis of about 66 per cent. of the net receipts.

Storage Battery Stations.

Referring to a recent leader in our columns on an American engineer's criticism of European central stations, we remarked that the critic did neither himself nor us justice, and we still maintain our views although the *Electrical Engineer*, of New York, states the gentleman is "known everywhere as an able and most careful engineer." No doubt many of the smaller American central stations will be glad to profit by European practice and to use accumulators for the hours of light loads; and probably the gentleman in question will adopt the same means of economising capital outlay and securing a minimum cost of running when the design of a small station is placed in his hands.

Trolley Cars in New York.

We are glad to note that the Metropolitan Traction Company, of New York, has at last obtained permission from the authorities to run trolley cars into the city proper under the elevated roads and elsewhere. We referred to the strange action of the New York civic powers, with reference to electric cars, in a leader some few weeks ago; in this we mentioned the strong opposition of the press. We are glad to gather from our esteemed contemporary, the *Electrical Engineer*, of New York, that though the antagonistic articles are continued, they in no wise represent the opinions of the New Yorkers. The trolley is likely to prove as great a boon in this city as in every other city or town where it has been installed.

Niagara.

Last week we discussed at some length the prospecting and hydraulic works which are going on at Niagara Falls. In the concurrent number of *The Engineer*, both the hydraulic and the electrical sections of this great scheme for the utilisation of water power are described. "It is around the transmission of the electrical power part of the scheme," says our contemporary, "that the great interest is centred." In fact, we may justly claim that but for the electrical part of the scheme there could be no hope of its successful issue on so large a scale. Part of this section of the scheme will consist in the transmission of about 5,000 H.P. to Buffalo, where it will be used for lighting and power. The present cost of a steam H.P. year at that place is about $35, and it is estimated that a good profit will accrue to the supply company if the electric power is supplied at $10, with the extra advantage of a twenty-four hours' supply. No particular system of electric transmission has been definitely decided upon, a fact which is made evident by the contradictory accounts which reach us from over the water; nor is there any need for immediate decision, for the interval which must necessarily elapse before the electrical portion of the plant can be put in will probably witness some important developments in electric transmission. There is some talk of adopting the three-phase system, the current being transmitted at 5,000 volts; but it is probable that a simple alternate current system will be found to be suitable and finally decided upon. The difficulty with continuous currents is, of course, the destruction of the commutator at the necessarily high voltages. As an experiment, a small amount of power is to be transmitted to Chicago, a distance of more than 500 miles. For this purpose it will be necessary to employ even higher voltage, the 5,000-volt current being stepped-up to 25,000 volts at Niagara, and stepped-down to 1,000 volts at its entrance to Chicago. Our contemporary thinks it may not be too rash to opine that the day is not far distant when the New York printing presses will be run by Niagara power. We hope our contemporary is right; for if it is, the day is also not far distant in which we shall see some material improvement in our electrical systems of long distance transmission. Much will have to be changed before electrical power supplied from Niagara can compete with steam and gas engines at New York.

THE HAULAGE OF CANAL BOATS, AND MONS. DE BOVET'S MAGNETIC PULLEYS.*

By G. PELLISSIER.

The conveyance of goods by water is of considerable importance in France. During the year 1891, 15,925 vessels carried, either by river or canal, 25,181,056 tons of merchandise which could not bear the greater cost of carriage by rail. A small number of these barges are carried by the "stream," but most of them are towed by steam boats; either by *toueurs*† hauling on a chain under water, or by tugs, properly so-called, with paddle-wheels or screws.

The invention of sunk chain haulage dates, it is said, from 1732, and is due to Marshal Saxe; the working was similar to that of warping vessels by capstans, one end of the rope was fixed to the ground ahead of the boat and the other was passed round a winch on board worked by horses. When the rope was all wound in, one end was again carried forward and the manœuvre was thus repeated time after time.

Some experiments made by Messieurs Tourasse and Courteaut, on the Saône in 1820, and on the Rhone in 1822, with steamers, gave satisfactory results; they were tried about the same time on the Seine, by Messieurs de Quémont and de Rigny, but it was 1832 that gave birth to haulage by means of a chain sunk throughout the whole route, according to the arrangements adopted by Messieurs Tourasse and Mellet.

The first Grande Compagnie de Touage, that of the lower Seine and the Oise, which works a route of 72 kilomètres with considerable traffic, was founded in 1856; its organisation has been the model for most of the other French or foreign companies. The dummies go backwards and forwards on the chain without leaving it, and are numerous in proportion to the traffic.

When two boats from opposite directions meet, the freights are exchanged, and each travels back again over the route it has just come until another boat meets it and exchanges its cargo; in fact it is a service of relays.

The chain is wound on board round two drums having five grooves, with parallel axes three mètres apart, and makes sufficient turns to give the necessary grip (usually four half turns on each drum).

The superiority of the chain over steam tugs is greatest when the current of the water is most swift; a few figures will show the importance of it.

Although the Seine has been very perfectly canalised, allowing tugs to work under the best possible conditions, the latter are so affected by the variations of the current that a screw steamer which can tow seven barges in summer when the water is low, can only bring up one when the water is very high, and at ordinary high water it takes two tugs to draw three barges.

Consequently the number of tugs required is four or five times greater in winter than in summer. As the traffic is particularly regular, the greater number of the tugs are unused during from three to five months of the year.

Haulage by a fixed chain, which is much less affected by variation of the current, admits of a more regular service; the weight of goods that a "dummy" can draw is reduced in the proportion of 5 to 10 at high water, and the slighter variations which have a considerable effect on the tugs are not so apparent.

Besides these important advantages, chain haulage has some great drawbacks which so far have delayed its development. In the first place in low water it costs much more than the tug. Soon after its introduction the expense of barge traction fell from 0·03 fr. to about 0·01 fr. per ton kilomètre. But now, the tugs have benefited by all the improvements made in steam and by the building of canals, and have lowered their freight very considerably, so that chain barges which, to begin with, transacted 90 per cent. of the whole traffic, have at present only about 50 per cent. of it.

In addition, the establishment of canals having reduced the current, travelling by the stream is no longer possible, and chain barges are very ill-suited for the service of the *descente*; at high water especially, if a "dummy" going with the stream draws a train of barges, its speed being limited by the drawing apparatus on the chain, is insufficient for the control of the barges, and the exchange in relays takes much longer, is more complicated and more dangerous. And finally if the chain should break the "dummy" stops, held by the chain rolled round the windlass, and the barges being towed may collide, and damages more or less grave are often the result.

These are the causes of the very natural reluctance of lightermen to make use of chain barges for the *descente*, and of the corresponding development of tugs. There are actually in France 113 cargo boats with paddles or screws, and 287 tugs, representing a total motive power of 34,424 horse-power, while the *toueurs*, with 74 boats, give only 3,514 horse-power.

Owing to the method of hauling, the chain often breaks; if the grooves of the windlass drums are not absolutely identical the chain slips from one groove to another, and abnormal tensions are produced on the part between the drums, which much exceed the tractive effort on the part in front of the boat. In addition to this the tension of the chain is tightened and loosened eight times in its passage round the windlass, which, when a little sand is collected on it, causes wear and tear of the metal.

Haulage by *rope* has been tried, but in most cases without success; the various companies which have attempted it have been compelled to give it up; except in very special cases (like the Rhine, for instance, on account of the nature of the bottom), it is always inferior to haulage by a sunk chain.

During from three to five months of the year, the chain offers striking advantages over tugs; but for the rest of the time it is in a condition of inferiority, which causes the balance to lean in favour of its competitor, in spite of great inconveniences.

If it were possible to obtain *toueurs* combining their own advantages with those of the tugs, the result would be very favourable to water traffic, and, finally, a decrease in the freightage.

Many engineers have endeavoured to solve the problem; but the greater number have been obliged to give it up owing to the great difficulties. The service demands paddle or screw tugs, furnished with hauling apparatus, which they would use only up stream. The necessity of throwing the chain into the water at any part of the route, does not permit of making even one complete turn on the drum; the same motor having to work the screw and the winch, the diameter of the hauling pulley must be very small (about 1 metre), so that a large number of teeth is not permissible in the gearing to reduce the speed. And yet under these conditions it is necessary to get grip on the chain sufficient to equal the tractive effort, which often reaches from 4,500 to 5,000 kilogrammes. Every mechanical solution yet suggested has great drawbacks and not one has been tried.

Monsieur de Bovet, director of the Compagnie de Touage of the lower Seine and the Oise, has found a solution at once remarkably simple and completely efficacious, by magnetising the groove of the hauling drum. The magnetic pulley that he has invented is capable of numerous applications and is of great interest.

This engineer and Monsieur Molinos gave the result of the experiments which have been made to the fifth International Congress of Navigation, held at Paris at the end of last July; it is from this paper that we borrow the details contained in the present article.

The magnetic pulley (fig. 1) is essentially composed of a soft steel shaft, A, upon which is placed the drum, M, whose cheeks, B, B, which form the poles of the magnet, are distanced from each other around the circumference, as is shown in the design, and grooved so that the chain, whose links present themselves successively, fit with the least possible play. A metallic ring, D, with india-rubber joints, completely closes the seat of the chain, so as to prevent water or dirt getting to the inside of the apparatus. The electric current is brought to the bobbins by means of two ring collectors and two wires which pass through the centre of the hollow shaft. When the magnet is excited, the chain passing in the groove of the pulley completes the magnetic circuit, and is held firmly in position by the magnetic attraction.

* Translated and abridged from *La Lumière Electrique*.

† *Toueurs*, literally a tower, may, for the purposes of this article, be considered as a "dummy barge" carrying a winch to haul on the sunk cable; it corresponds to the "dummy car" in cable tramwork.

In the trials which have been made at the workshops of the constructors, MM. Sautter, Harlé et Cie, with a pulley having a coil wound with 29 layers of 27 turns each of a wire 5 millimetres in diameter; a current of 48 ampères with 70 volts gave sufficient grip to transmit 4½ horse-power. The grip under these conditions is from 6,000 to 6,500 kilogrammes, with an old worn out chain reduced to about half its original weight; with a new chain the grip will be approximately equal to a strain of from 8 to 10 tons. A grip of 6,000 kilogrammes is more than sufficient to assure the traction in the most difficult parts of the route, with a heavy

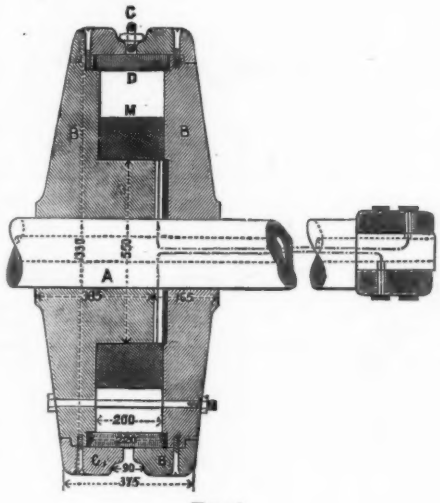


Fig. 1.

load and highest speed. The reduction of grip with a chain just raised from the water, that is to say, wet and covered with the little leeches which, being crushed, will lubricate the surfaces in contact will be about 10 per cent. less than that in the experimental trials. This slight diminution of friction is caused by the mechanical and not by the magnetic conditions.

The service speed being about 1 metre per second, the coefficients of friction are the same as those of repose; the figures obtained from the trials are thus applicable to practice.

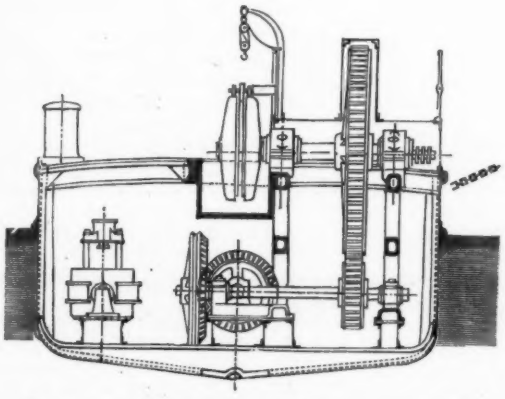


Fig. 2.—Section Amidships, Electromagnetic Tug.

The whole arrangement is very simple; the maintenance is confined to the replacing of the brushes and to the renewal of the pulley teeth, which wear out by the friction of the chains. To facilitate the renewal, the cheeks are composed of two rings shown at B_1 and C_1 in fig. 1, which are very easily changed. To prevent the leakage of the lines of force, the bolts of the exterior shell are made in gun-metal.

The new chain barge destined to work with this magnetic pulley has been built by Mons. Satre, of Lyons. Its length is 33 metres, breadth inside the ribs 5 metres, the hold is 2·7 metres, and the mean draught when loaded for hauling is 1·9 metres. It is fitted with a propeller of large diameter, coupled direct to a vertical compound engine. The shaft turns at a speed of 150 revolutions per minute and absorbs 150 H.P.

The magnetic pulley is geared to run at 90 revolutions per minute by means of toothed gearing (see fig. 2), and then develops about 90 horse-power. The boiler, tested to a pressure of 8 kilogrammes per square centimetre, presents a total heating surface of 100 square metres. The chain is extended, as in the actual system, from one end of the route to the other, but the relay service is done away with. This "dummy" will take a barge from any point to its destination without change of cargo, which has the advantage of economy of time and of greater security.

The chain guided by idle pulleys makes about three-quarters of a turn around the drum, and falls into the water with a speed controlled by means of a brake. The guide pulley situated on the side on which the chain leaves the drum is of iron, so as to be partly magnetised, and the detachment of the chain is facilitated by means of a metal piece shaped to fit the groove. The entering guide pulley is, on the contrary, made in non-magnetic metal. If the "dummy" has to be reversed the chain is thrown out of gear by a lever.

The electric current is produced by a little steam engine coupled direct to a dynamo, the whole of which is very compact, and is placed beside the large engine under the supervision of the driver. This, in common with all the electric parts of the system, has been supplied by Messieurs Sautter, Harlé et Cie. The current is regulated by means of a rheostat placed beside the captain; and also beside him is the rheostat to control the chain brake. This brake comprises a magnetic pulley around which the chain makes a quarter of a turn; an iron shoe, having very little play, is placed upon the opposite quadrant of the pulley; when the current passes through the bobbin the chain presses upon the pulley and this upon the shoe, so that it can no longer turn. The braking effect is proportional to the intensity of the current, the paying out taking place under the resulting action of the weight of the falling chain and the friction of the brake, and so can be controlled at will. This is a very important consideration. When the chain is slack, a portion is wound on board and stored in a convenient hold, and this is "payed out" when the tension becomes too great. This arrangement facilitates the working of the barge, especially when going round bends.

When the brake is down, the chain is wound into the hold by means of the entering guide pulley, which, being driven by a separate motor, can be started and stopped at pleasure. There are but three metres of chain upon the drum, and there is no difficulty in throwing it into the water if it becomes dangerously slack, when the dummy is coming down stream.

To sum up: "The simplicity of the chief apparatus is extreme, and it is not easy to see how it can be well surpassed. The power necessary to ensure the grip is very small: the one motive pulley does away with all the difficulties connected with the different diameters of the two pulleys. Also the apparatus is self governing as regards the pull exerted, since the friction of the drum is proportional to the current in the bobbins; and it cannot give a greater tractive effort than that predetermined by the conditions of the work, and modified at the will of the captain. If experience justifies these expectations, haulage thus carried out will constitute the best solution of river and canal traction; and to conclude we may state the advantages thus:—

1. With reference to the system of haulage commonly employed.—Considerable reduction in the wear of the chain, removal of the chief causes of breakages, the doing away with the tedious system of relays, better utilisation of material, increase of the volume of traffic, and reduction of the cost of maintenance.

2. With reference to the tugs.—Equal advantages at low water; incontestable superiority at high water.

Electricity appears to furnish an economical solution of the problem. Steam or hydraulic engines would be utilised to produce the electric current at suitable places, and current would be supplied to cables erected on either bank; one cable being used by boats going up and the other by those going down stream. On board of each barge there would be placed an electric motor coupled to a magnetic

pulley of 40 centimetres diameter, upon which would be wound a chain weighing 4 kilogrammes per metre, which would give the barge a speed of 8 kilometres per hour with a force of 3 horse-power. There would be in large canals with much traffic two chains, one for "up" and one for "down" traffic.

Altogether the motor and pulley would not weigh more than 1,500 kilos, with overall dimensions of say, 1·25 m. by 1·25 m. by 0·8 m. They would be shipped on the barge at the entrance to the canal and removed at the other end and transhipped to a boat returning. This would be easy enough when the traffic in either direction was sensibly equal.

The current would be collected from the cables on the banks by means of a trolley carried on the mast of the boat. The two wires would be coupled together at suitable intervals and the return would be made by the chain and the water of the river or canal. The electric part of the system has been studied by M. Picon, and he proposes that the distribution should be at a low tension.

The advantages offered by the independent motors and the facilities of erecting and inspecting them would soon cause this mode of traction to be adopted. If applied to a short canal, with a heavy traffic, it would give greater economy and higher speed than that now obtained.

It would be, in fact, the system of electric tramways applied to the traction of boats. The flexibility of the service with the magnetic pulley would be particularly favourable, for it permits of considerable variations in the tractive efforts; and if at any moment the strain exceeds the predetermined limit the chain would slip and not break—this will be most important in a canal service.

Another engineer, Mons. L. Busser, has also designed an electric system of haulage for canals. Neither of these methods have as yet been applied in practice. We will not dwell upon the subject further now, but we shall return to this interesting application when it has received the sanction of practice.

ELECTROSTATIC SWITCH AND PHASE INDICATOR.

This is a device designed mainly for automatically throwing alternators into parallel. It is also said to be useful for indicating when line currents or machines are in phase. The instrument will be readily understood from the figures 1 and 2, as taken from the *Western Electrician*.

It is simply a balance, one arm loaded with an aluminium disc, E, and the other with a copper prong, S, over a pair of mercury cups forming a switch. It depends for its action on the attractions and repulsions due to difference of phases or coincidence of phases in E.M.F. It does not indicate phases or difference of phases in current; it can only indicate the phases of E.M.F.

The idea is ingenious, but such an instrument must of necessity be far too delicate for any practical purposes. The balance must be delicately poised to get any motion at all due to attraction or repulsion, with only a few thousand volts difference of potential between two small plates, and the repulsion begins not when the two potentials are in phase but immediately they pass within 90 degrees of being in phase, and the repulsion increases from that point up to a maximum, when the two potentials are in exactly co-phased synchronism. It will be quite obvious that the adjustment of a balance so fine that contact will be made at or near the exact time would be difficult to make and more difficult to maintain, and, moreover, the mercury switch is very objectionable. Mercury switches require deep immersion of the copper or other prong to ensure good contact; mere surface contact cannot be relied on with mercury, as the surface is always dirty. To immerse the prongs sufficiently would require much more force than could possibly be exerted by static repulsion at low pressures, comparatively, and by a single pair of plates.

To make the invention a success for throwing in alternators in parallel the static switch should be used only as a relay to complete a circuit through a magnetic switch having plenty of power to effectually close the circuit of the alternator, but even then the delicacy of the balance is objectionable, and, perhaps, dangerous.

This instrument might be used to roughly indicate phase differences in alternating motors running synchronously, but not in co-phased synchronism; and it might be re-designed to indicate at a central station to the attendants whether alternators running in parallel were actually co-phased synchronous or not.

As it is described, the instrument would stand at a perfect balance in two cases; first, when there was no potential difference between the plates, and, second, when the potentials

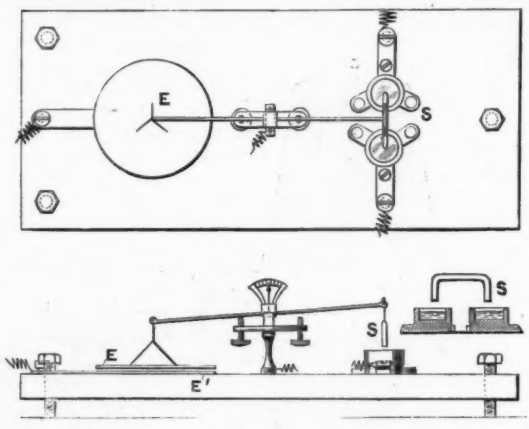


Fig. 1.

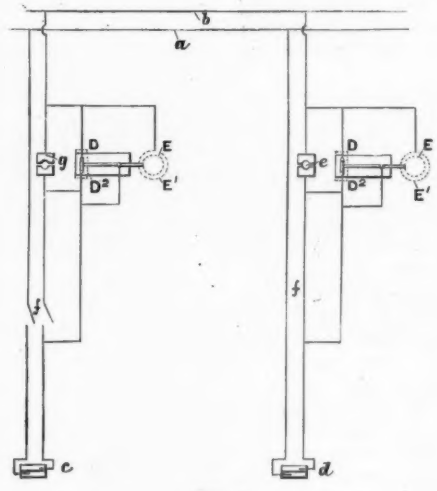


Fig. 2.

were in quadrature phase, and as the phase difference varied between one side or other of quadrature, attraction or repulsion would occur.

Many proposals have been made for constructing phase indicators; none of them have succeeded hitherto. We purpose returning to this subject shortly and describing some of the methods in use and proposed.

As for the automatic closing of circuits for throwing in alternators in parallel, we don't think there would be any advantages in automatic over-hand throwing in, rather the reverse; we think automatic throwing in devices might be rather dangerous, while throwing in by hand is the work of a few minutes and quite certain.

Proposed Electric Lighting at Bristol.—A committee has been appointed by the St. George (Bristol) Local Board to consider the question of electric lighting. At present about £1,800 per annum is paid to the gas company, but the amount is increasing, the district being a very populous one. The clerk has written inviting several firms to visit St. George with the view of tendering.

THE PYKE AND HARRIS LABORATORY ALTERNATOR.

We understand this to be the smallest alternating current dynamo ever placed on the market.

It stands on a base 20 inches by 9 inches, and is capable of giving, at the extraordinary low speed of 740 revolutions per minute, over 1 H.P. of electrical energy.

The field is excited by one or two primary cells, and it is claimed that the efficiency of the machine exceeds 80 per cent. The field, with the exception of the laminated portions, is turned from a single piece of wrought-iron, which serves also as the standard, carrying the gun-metal spindle-bush.

At a speed of 2,000 revolutions, the output of the machine is as great as 1½ kilowatts. This great efficiency may be ascribed to the close construction of the magnetic field, and the fact that the whole of the metal, subject to even the smallest variation of magnetic density, is laminated. The simplicity of the machine, as well as its non-liability to damage, must be obvious to anyone acquainted with the structural design, as there is nothing rotating save the pulley, spindle, and the inductors, with their carrier, forming in all one simple metallic mass, devoid of any electrical windings or connections.

THE INFLUENCE OF NON-ELECTROLYTES ON THE CONDUCTIVITY OF ELECTROLYTIC SOLUTIONS.

Whatever may be thought, by one school of physicists, of the theories advanced by Arrhenius, the fact remains that he rarely touches any field of research without throwing light upon hitherto obscure matters; and this fact will influence many workers, even though prejudiced by their own training or habit of thought, to give serious and favourable attention to his hypotheses.

Recently he has been studying the effect produced on the conductivity of aqueous solutions of electrolytes by replacing a portion of the water by liquids which are not electrolytic in their behaviour. In his experiments the total volume of the mixed solvents remained the same as before admixture with the electrolyte. He found that the electrolytic conductivity was diminished under these circumstances, and that, considered mathematically, if the quantity of non-electrolyte added is less than 10 per cent., the conductivity of the solution may be expressed by the following equation, viz. :—

$$l = l_0 \left(1 - \frac{a}{2} x\right)^2$$

where x is the amount of non-electrolyte added.

„ l_0 is the conductivity of the pure aqueous solution.

„ a is an empyrical constant.

During this investigation, Arrhenius experimented with upwards of 50 different electrolytic solutions and examined the influence upon their conductivity by mixing them with the following non-electrolytes : methyl, ethyl and isopropyl alcohols, ether, acetone and cane sugar. These were, of course, not all mixed in the same given proportion ; the quantities of non-electrolyte and the strength of the solutions were varied.

The decrease of the conductivity brought about by the addition of 1 per cent. by volume of the given non-electrolyte (*i.e.*, the coefficient a), depends on the nature both of the electrolyte and of the non-electrolyte, varying between 1·5 and 4 per cent. of the conductivity of the pure aqueous solution. As the concentration of the electrolyte increases, a is in general the greater ; and the variability of a with the concentration is such that it is smaller, the greater the degree of dissociation of the electrolyte.

Arrhenius deduces from his results that the diminution of the conductivity by the addition of a non-electrolyte is due, at least to some extent, to the increase of the fluid friction of the solution, which, as he puts it, lowers the speed of the ions. Most of the salts, strong acids, and bases are strongly dissociated ; and in the case of these substances the diminution of the conductivity is due almost entirely to this cause. The relation between it and the increase of fluid friction may be expressed by the equation

$$100\,a = c + 1{,}000\,c'\,(A - 1).$$

Where A is the fluid friction (compared with that of water which is taken as unity) of an aqueous solution, with 1 per cent. of the water replaced by the non-electrolyte ; whilst c and c' are constants, being the same for various groups of electrolytes. Here the addition of the non-electrolyte does not alter the degree of dissociation. On the other hand, when the dissolved substances are only feebly dissociated, the addition of the non-electrolyte not only diminishes the speed of the ions, but also diminishes their number.

The diminution of the degree of dissociation of the dis-

solved substances is greatest with non-electrolytes that contain no hydroxyl groups, and it becomes less as the number of these groups in the molecule increases.

The influence of temperature is not very pronounced ; but the proportional diminution of the conductivity always becomes smaller as the temperature rises.

In his paper, which may be consulted in the *Zeit. physikal chem.*, ix., pp. 487—511, Arrhenius indicates how to correct the observed conductivity of a solution for fluid friction, so as to reduce the value obtained to that in a liquid, the fluid friction of which is equal to that of pure water ; and finally suggests a method of applying observations on electrolytic conductivity to chemical analysis.

WATER POWER.

By E. TREMLETT CARTER.

(*Continued from page* 455.)

X.

34. *Parallel Flow Turbines.*—In these engines the guide trough or *chute* is placed above and parallel with the vane wheel, so that the water is guided along a path parallel with the axis of motion. Parallel flow turbines are usually designed to work with complete flow in all the vanes at full gate, and at more or less partial flow as the gate is lowered; they are sometimes worked with complete and sometimes with partial filling of the vane space. On this account they are more especially adapted to work on low or moderate falls, though in some cases they are designed to work with partial flow to meet the demands of higher falls. In the parallel flow turbine the centrifugal force on the water has no effect on its velocity of entry, neither producing a back pressure, as in the inward flow, nor suction, as in the outward flow ; so that there is no objection to fitting a suction pipe to those patterns which are designed to have complete filling of the vane spaces. Indeed, owing to the fact that these engines are most frequently employed at low falls, the use of a suction pipe is particularly desirable. For if the engine is hung free of the tail level, it must be placed high enough to be dry even in the heaviest flood that may reasonably be expected, which will necessitate its being a very wasteful distance above the tail level in ordinary conditions of the stream. With a suction pipe the head will be utilised right down to the tail level, whatever the condition of the stream ; and, since the flood which drowns the tail also raises the head water, the available fall will not suffer much change. Wet seasons do not seriously alter the available head in any case ; but the dry seasons are very injurious to engines which are hung free, for they rob the tail and the top level, thus doubly robbing the engine of its head, besides taking a large fraction from the flow of the stream. As a set-off to this, it must be remembered that engines which are hung free will work more efficiently at partial gate than will those which are allowed to be drowned with dead water.

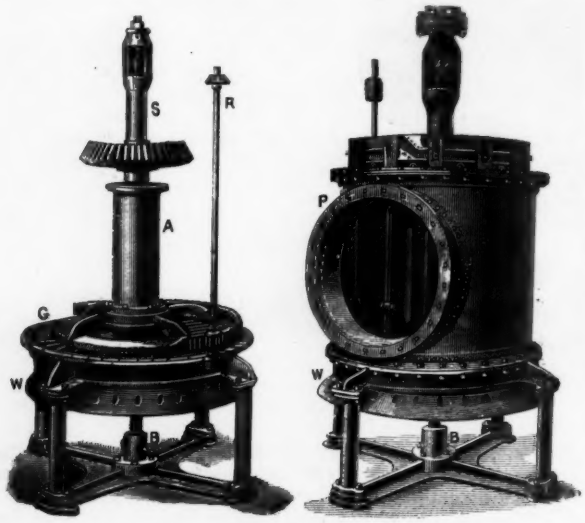


Fig. 42.

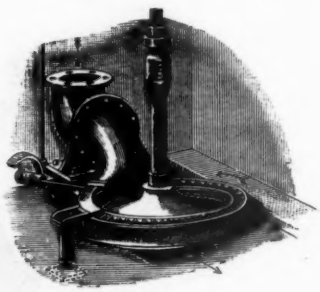


Fig. 43.

Two examples of parallel flow turbines will be given ; one an engine which must be hung free, the other an engine usually supplied with a suction pipe. The first is the Girard turbine, two diagrams of which are shown in fig. 42. The flume casing is shown only in the left-hand diagram, but is employed in both patterns. Water is supplied to the flume through the pipe, P, and descends to the guides, G, which are arranged in a ring just above the vanes. These latter are fitted to a wheel, W, which is supported on the step, B, by means of the spindle, S, which also transmits the power to the gearing. A sleeve, A, protects the spindle from the water in the flume and prevents leakage. At full gate all the guides are open and all the vanes receive water ; but at partial gate some of the guide channels are closed, so that water is supplied to only a few vanes at a time. The manner of closing the guides in the smaller engines is shown in the right-hand portion of fig. 42 ; and, in the case of larger engines, in the other portion. In one case a rod, R, turns a pinion which, gearing into a segmental wheel, causes a shutter to open or close over the channels, according to the direction in which R is turned. In the other case, a number of vertical

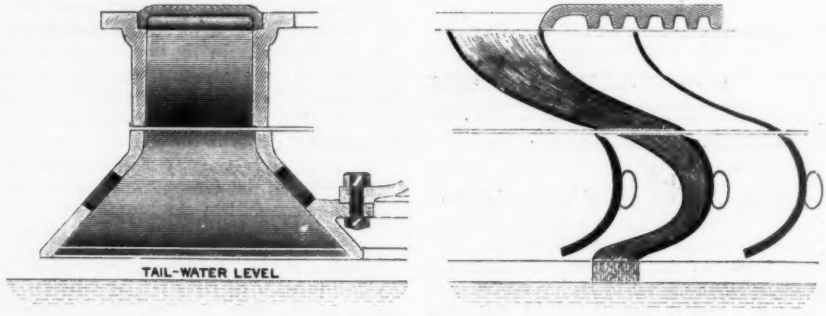


Fig. 44.

rods having plugs fixed to their lower ends, are raised or lowered, so as to open or plug up the channels. By turning the cam plate at the top of the engine a number of pins attached to the tops of these rods will be lifted from the bottom to the top slot, and the guides opened. For high falls the engine is designed to work with partial flow, only six guides being employed at full gate. These guides are opened or closed by means of a segmental wheel, as shown in fig. 43, which gives a general view of this type of Girard engine. Since these engines work with partial filling of the vane spaces, it will be necessary to provide a wider passage for the water as the point of discharge is approached. This is effected by flanging the vane trough, as shown in fig. 44. As the water diminishes in velocity, owing to its having done work, it spreads out over the widening vane surface, and thus the choking back pressure which would arise from complete filling, is prevented.

The Jonval turbine, which works with complete admission and filling, and which can on that account be fitted with a suction pipe, resembles the Girard engine in many respects, especially as regards the general arrangement of the parts. The vane trough, however, is not flanged, so that the water passage is of the same section throughout, and a back pressure is set up which reduces the admission velocity. As in the vortex turbine, a portion of the head at the point of admission is due to pressure, though this arises from a different cause. The feasibility of working these engines with a suction pipe renders them peculiarly suitable to those sites where there is a low and variable fall; it also enables the engine to be placed on a horizontal shaft, and thus to be brought more conveniently to the work it has to do. One of these turbines, arranged for a fall of about 5 feet, is shown in fig. 45; about half the fall taking place in the flume or penstock and the other half in the suction pipe. Such an engine might be flooded to the extent of 18 inches or two feet in the tail without experiencing any loss of power, provided an equal rise could occur in the flume.

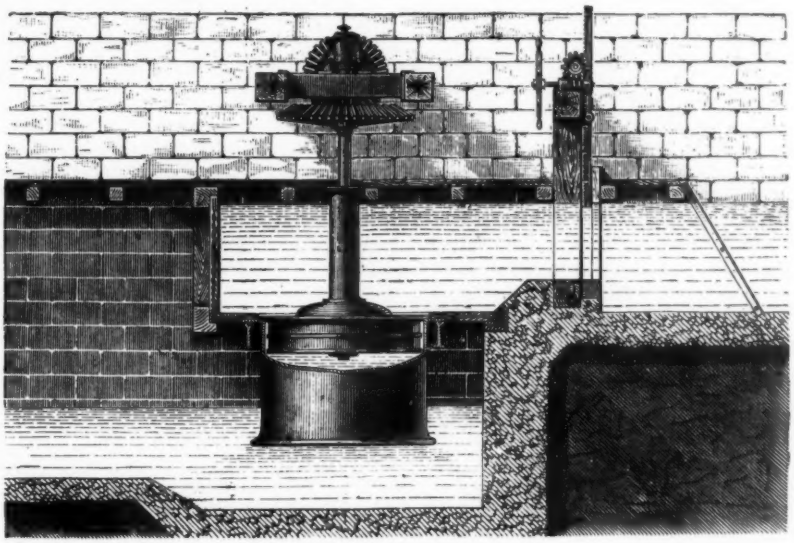


Fig. 45.

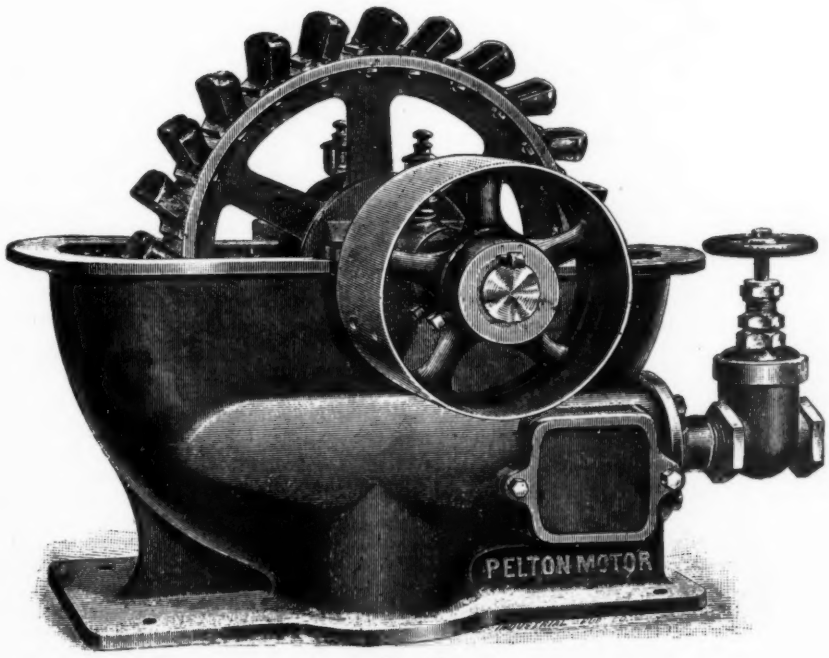


Fig. 46.

Regulation of the Jonval turbine is carried out in several ways. In the horizontal pattern, fitted with a suction pipe, there is sometimes a throttle valve placed in this pipe immediately below the engine, and sometimes the suction pipe is made telescopic, so as to vary the clearance between its lower

edge and the floor of the wheel pit, a floor plate of cast-iron being laid to prevent scouring. Both these methods are defective—firstly, because they cause a variation in the velocity of the water on its entering the engine; and secondly, because they suddenly constrict the passage of the water and cause a serious loss of head. The vertical pattern is usually fitted with a much more efficient regulator, consisting of a slide which covers more or less of the guide passages.

35. *Jet Turbines.*—Where a jet of water acts on the turbine tangentially to the circular path of its motion, and is discharged in a plane which is also tangential to the wheel, we have a jet, or tangent turbine. The best and most largely employed example of this class of engine is the well-known Pelton wheel. In this turbine, a general view of which, with a part of the casing removed, is shown in fig. 46; one or more jets of water are caused to play on a number of curved vanes bolted to the rim of an iron wheel. The impulse of the water against the curved vane causes a tangential thrust which turns the engine, the water gliding away to the right and left of the wheel and falling into the wheel pit or tail race. This action is more clearly shown by fig. 47, in which the double vane, V, V, moving along the line, O, X, is acted on by the jet, J, which issues from the nozzle, N, with a velocity equal to that due to the total effective head. Striking the vanes in the direction of their motion, the water divides into two equal portions, and glides away towards the edges of the wheel path, being discharged at the lips, L. In this type of engine it is possible to direct the water on to the vanes with absolutely no inclination towards the centre, *i.e.*, the angle, α, may be zero. In the Pelton wheel this angle is zero; so that if the water could be discharged in exactly the opposite direction to the motion of the vane the hydraulic efficiency might be 100 per cent. In practice it is found to be impossible to allow the water thus to escape, it being necessary to give the discharge a slight direction outwards away from the wheel in order to prevent collision between the dead water and the next vane that comes into action. The water is therefore discharged along a path, A, C, relatively to the direction of the wheel path, the lip being inclined at a small angle, ϕ, for this purpose. Now, it is evident, from theory, that the absolute path of the discharge should be at right angles to the direction of motion of the vane, so that the water should move along the line, C, B, as it leaves the lip. To effect this, it will be necessary to give the vane itself a velocity which is represented by the line, A, B. Assuming that the vane is run at this velocity, which for obvious practical reasons must be lower than the velocity of the jet, we have for the waste energy:—

$$E_2 = \frac{62{\cdot}4\ Q\ (v\ .\ \tan\phi)^2}{2\ g},$$

and for the energy supplied:

$$E_1 = \frac{62{\cdot}4\ Q\ (V)^2}{2\ g}.$$

So the efficiency is:

$$\eta = \frac{E_1 - E_2}{E_1} = 1 - \left(\frac{v\ .\ \tan\phi}{V}\right)^2.$$

Since the velocity of the wheel is usually about half the velocity of the jet, the angle ϕ must be such that:

$$\tan\phi = \frac{V}{v}\ .\ \sqrt{1-\eta} = 2\ \sqrt{1-\eta}.$$

Thus the velocity can be adapted to give a very high efficiency, whatever the head under which the wheel is to work. For example, if the angle at the lip is 10°, a velocity of 45 feet per second under a head of 100 feet—the jet moving at about 80 feet per second—would give an efficiency of 99 per cent., or a commercial efficiency exceeding 80 per cent.; while under a head of 1,000 feet the same degree of efficiency would be realised by running the wheel at about 140 feet per second, the jet moving at 250 feet per second. The highest head to which, up to the present, these engines have been applied is on the Comstock, where six large Pelton motors are running under a head of 1,680 feet, with a commercial efficiency of 85 per cent. The Comstock plant is for the electrical transmission of power.

These high velocities under large falls put a severe strain on the vanes and the rim of the wheel, necessitating that they should be constructed of phosphor bronze or tough cast-steel; when designed for lower velocities the parts are usually of cast-iron. Further details of the Pelton engine will be given in the sequel.

ERRATUM.—The equation to the shape of a vane curve, given in paragraph 29, should have been—

$$y = \frac{v\ .\ x}{V\ .\ \sin\alpha}.$$

(To be continued.)

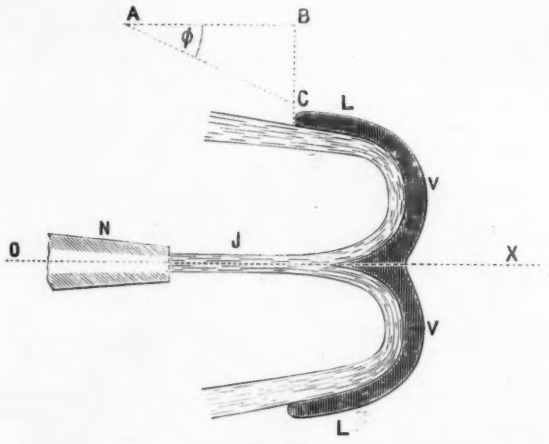


FIG. 47.

SOME ANOMALIES IN DYNAMO DESIGN.*

IT is frequently stated that no one can design a dynamo who is not a trained engineer. If this be the case, dynamos must be in rather a backward state, for very few dynamos are nominally designed by engineers. On the other hand, an eminent and very successful dynamo maker has said that a "cow of average intelligence could design two bearings, and that is all the engineering there is in a dynamo." Probably the truth lies between these extremes. There is not much engineering construction in a dynamo, and in most cases the machine bears the name of this or that electrician, while all the engineering details are worked out by experienced draughtsmen, who get little or no credit for their work.

Some years ago the complaint was made that dynamos were mechanically bad. The armatures were mounted on wooden hubs, and the machines looked as if they had been made by an optician. Now we are going to the other extreme. In order to appear "a thoroughly mechanical piece of work," a dynamo is made with a ton or two of extra cast-iron, parts having stresses in pounds but made heavy enough to stand pulls of many tons. The most serious forces in a dynamo are the magnetic pulls of the fields on the armature

* *Industries.*

or on one another, but these receive very little attention. Few dynamos are designed to take these pulls fairly, and their value in pounds or tons is very seldom worked out. The air space in many dynamos decreases visibly when the field is excited. Still, these pulls are steady, and not intermittent, so little harm is done, though badly designed machines have come to grief from this cause. It is now the proper thing to admire a large and clumsy dynamo, on the ground that it is "a good solid mechanical machine." At the recent Crystal Palace Exhibition, any machine that was big and imposing as a structure had an admiring crowd round it. No inquiries were made as to what its output was, or what it cost. If it weighed 20 tons and gave 20 kilowatts, all would be quite satisfied and delighted. A very small machine is not necessarily cheap to make or good to work, generally the reverse; but a machine that is too large for its output is also always bad and expensive. The most common method of making a dynamo into a "good solid piece of engineering" is to develop its bed-plate to an abnormal extent. But the only important stresses in a dynamo are internal; the motion is steady, and the other forces in the machine are insignificant. It is, therefore, unnecessary to mount the machine on an extensive substructure of hollow cast-iron work. Many modern dynamos look as if their designers thought they would bend unless carefully secured to good solid foundations of rock by means of ample castings capable of withstanding the enormous stresses derived, presumably, from the belts or ropes. The illusion is generally entirely spoilt by hoisting the whole thing on to two little slides, so as to admit of tightening the belt. There are many odd sights in electric stations and installations, but few are stranger than a dynamo with a ponderous bed-plate mounted on foundation rails. If the machine is designed to be used on foundation rails, the bed-plate might be omitted, and full provision made for the dynamo to rest on the foundation rails, but it should not look as if it were trying in vain to sit down upon a large area, but could not reach the ground. If a casting is needed to form the framework of the dynamo, it should be arranged as a frame, and not as a bed-plate, and it might be designed much in the same way as the entablature of a paddle-wheel engine.

Any good impression that might be made by the imposing amount of cast-iron in a modern dynamo is sadly weakened by the eyebolt with which an electrical engineer always crowns his work. The eyebolt suggests that the dynamo may break down at any instant, and can be whisked off—if such an expression can be used without disrespect to the bed-plate—and replaced by another at a moment's notice. The electrician's eyebolt is almost unique. Cylinder covers, piston rods, and other parts of marine engines have eyebolts; but they are inserted and taken out by hand when the vessel comes into port. Engineers do not provide eyebolts in other cases. The boilers of a steamer, for instance, are dropped in without difficulty, and an engine-maker does not send out, say, a hundred-horse stationary engine all in one piece with an eyebolt, so that it can be lifted like a dynamo or a lady's parcel. In spite of its odd appearance, the eyebolt has some advantages. But the money spent in making it, and carefully polishing it all over—a most essential process it would seem—can hardly be saved in reduced cost of carriage, due to ease of lifting in those cases where sufficiently powerful cranes are in use.

Few dynamos appear as if complete drawings had been made before building. Apparently the drawing office gets out the frame of the machine, and some other department winds on the wire. The erectors at last find that there are a number of connections to be made, and the appearance of the machine is spoiled by the addition of rods and bars of silk-taped copper straggling about in all directions. The terminal board is screwed on wherever there is room for it, having apparently been forgotten when the machine was designed. The windings, except in rare cases, are left exposed. Sometimes they are painted red. This is a survival of the days when opticians painted electrical apparatus with red sealing wax varnish. They ought, of course, to be covered in. In America they are sometimes roped, but rope is a bad conductor of heat. Besides, a dynamo has already so much paper, cotton, vulcanised fibre, string, and other materials suggestive of postage-stamp edging and sealing wax, that it is a pity to use rope when metal can be employed.

After a few years' work most dynamos are saturated with oil. This is due to the design of the bearings not being thoroughly worked out. The drawing office designs a bearing, and the machine is sold, and nothing more is heard of it until the insulation breaks down, and it comes back to be re-wound; but even then nothing is attributed to the bearings. This is one of those cases—common enough in engineering—of want of touch between the makers and users of machinery.

COMMUNICATIONS FROM AUSTRIA-HUNGARY.

[FROM OUR OWN CORRESPONDENT.]

It is known that the Brush Company has for some time entertained the project of selling the electric works which it has erected at Temesvar, and which has hitherto proved very unremunerative. After the negotiations carried on with the gas company proved fruitless, the municipality of Temesvar itself entered into negotiations with Clements, the manager of the Brush Company. According to the data ascertained, the total capital hitherto invested in the installation amounts to 470,000 florins, whilst the company, to effect a sale, offered it for 300,000 florins.

According to the accounts, the net yearly income of the installation in its present state is 12,000 florins, taking into consideration the date of the last working period, as the income, in consequence of the erection of electric meters, has risen by almost cent. per cent. Notwithstanding this favourable offer, the town demanded further concessions, and the Brush Company is now prepared to reduce the purchase price to 225,000 florins, if the town will take over illuminative substances to the value of 25,000 florins. The town has now taken into consideration the procuring of capital for the purchase, so that a decision may probably soon be reached.

The Hungarian Minister of the Interior has sanctioned the resolution of the representatives of the City of Budapest, according to which the gas company, and the firm of Ganz and Co., are to obtain concessions for the erection of electric works simultaneously and on equal conditions, according to the tenders of the gas company, which are, financially, more favourable to the city and to the consumers. The City of Budapest has called on the firm of Ganz & Co. for a declaration whether they are prepared to sign a concession agreement with the city on the basis of the proposals of the gas company, to which this firm has replied in the affirmative. The gas company was also required to accept the more extended cable net projected by Ganz & Co., so that both undertakings must lay down cables in the main thoroughfares of the city, and thus compete with each other in all parts, for the benefit of the consumers.

The preliminary operations for the redemption of the telephone net of the Vienna Private Telegraph Company have been recently completed. Immediately after the return of the manager from his leave of absence, the negotiations for the redemption between the Ministry and the undertaking will begin, and will probably be completed in a short time. With the redemption of the Vienna Private Telegraph Company, the last private telephone net in Austria will have passed into the possession of the State. The private nets at Prag and Brunn have been already acquired, and the negotiations for the redemption of the net at Linz are already concluded.

The boards of the Austrian private railways have been called upon by the Royal and Imperial General Inspection to come to an early and trustworthy understanding with the two neighbouring stations for what purpose a portable telegraph apparatus is less practicable. Attention is also called to the field telephone (E. Gattinger's system), which possesses the essential advantage that within two or three minutes it may be inserted by persons without technical training, without the telegraphic intercourse being in the least disturbed by this arrangement, or by the subsequent working of the apparatus.

THE AMERICAN APPEAL COURTS UPHOLD EDISON'S INCANDESCENT LAMP CLAIMS.

THE United States Circuit Court of Appeal has decided that Mr. Edison was the first inventor of the incandescent lamp. The decision upholds the decree of Judge Wallace, given in July of last year, and reported in the ELECTRICAL REVIEW. It will be generally remembered that an action was brought in 1885 by the Edison Electric Light Company to restrain the United States Electric Lighting Company from making incandescent lamps which, it was held, infringed Edison's patents. This was not the whole statement of claim, but it was the main point. Judge Wallace ruled that there was an infringement, and the United Company appealed. The appeal has been lost, with the result stated above. The decision of the court is based on a most elaborate analysis of the art of making incandescent lamps. The following are the chief points of the judgment :—

In the lamp made by defendant the carbon conductor is not coiled as indicated in the third claim, nor is it secured as indicated in the fourth, nor does complainant contend that either of these claims is infringed. The Circuit Court held that the first claim was by its phraseology limited to lamps, in which (among other things) the leading-in wires are "secured to the filament according to the method of the patent, that is, by cement carbonised *in situ*," and that as defendant uses clamps for this purpose it does not infringe. This construction of the first claim has been acquiesced in by the complainant, which has not appealed from the decision. There remains for consideration only the second claim—the combination of the carbon filaments.

The defendants' burner is of carbon so small of cross-section that it may be fairly called a filament.

Prior to 1879, experimenters seemed to have reached the conclusion that success was to be attained, if at all, by modifications of the arc lamp; but up to that time no lamp, arc or incandescent, had been given to the public, which, with the means then existing for generating and distributing the electric current, accomplished this result. Since the date of the patent in suit, electric lighting by lights of moderate intensity has become a commercial success. Subsequent improvements in the lamps and in other parts of the system have undoubtedly contributed materially to its development, but the record abundantly shows that with lamps such as the patent (Edison) describes, constructed with the skill then known to the art, and operated under the conditions admitted by the generating and conducting apparatus then existing, it became practical for one generator to operate a considerable number of lamps, located at reasonable distances from it, and which, at the same time, were economical, durable and cheap enough to be commercially useful, and so simple and reliable, that they could be manipulated by the public.

Commercial and domestic exigencies required that the lamps should be so arranged, that each derived its power independently from a common source, and not through another lamp, so that they could be individually lighted or extinguished at will, and the breaking down of a single lamp would not break the circuit. This is effected by what is called the "multiple arc" arrangement.

Irrespective of all patents or publications of others, the philosophy of this method of producing light is undoubtedly found stated clearly and sufficiently, and applied to the production of an incandescent platinum burner, in Edison's French patent, No. 130,910, taken out May 28th, 1879.

In his invention, as described in the French patent, Edison departed from the existing idea of burners of low resistance, declared the commercial and scientific necessity of burners of high resistance, although they must be slender and presumably fragile, and attempted to find a method of protecting them from the effects of heat and of the atmosphere. Edison, in his French specification, followed the principle of high resistance to an extreme, made platinum burners with a resistance of 200 to 300 ohms, and described the method by which they were to be prevented from speedy deterioration, "by destroying or intercepting the atmospheric action." He freed them from occluded gases by subjecting them to a high degree of electrical heat in a vacuum, and subsequently sealed them also in a vacuum. The platinum lamp, however, did not achieve success.

Inasmuch as carbon has a specific resistance from 200 or 400 times that of platinum (hard, dense carbon having a lower resistance than porous carbon), is practically infusible, had been long before suggested as a translating device, and used as such in many of the lamps devised by the prior art, it might be supposed that, when one skilled in that art was seeking a substitute for the platinum wire—something which would, by reason of high resistance and small radiating surface apply the philosophy disclosed in the French patent and yet admit of operation at higher temperature without melting—he would have turned to carbon.

But the record in this case clearly establishes the converse of that proposition. Carbon, when exposed to the air at a temperature sufficient to produce incandescence undergoes combustion. To remedy this difficulty earlier inventors suggested enclosing the carbon burner in a glass globe, from which air and moisture were to be excluded. Their globes were separable to allow of replacement of interior parts. We do not find in the words "suitably sealed," used in the King patent (British, 1845, No. 10,919) to describe a modification of his lamp for use under water, sufficient warrant for the contention that its structure was to be so radically changed as to substitute a light and compact all-glass globe, with irremovable burner, for the cumbrous apparatus with its column of mercury which he describes in detail. Neither the enclosing chamber of Crookes nor the Geissler tubes—though being all of glass with wires sealed in they would not leak—were used by the prior art to protect incandescent burners. By reason, in part, of that mode of construction—with separable chamber—the vacua which the earlier experimenters sought to secure could not be maintained. Though subsequent improvements in exhaust pumps might give their apparatus a higher initial vacuum, it would rapidly disappear in the leaking globe. It was against the oxygen or other carbon-consuming gases that all prior inventors sought to protect the burner, and later inventors tried to accomplish the result by filling the chamber with nitrogen or some other gas, which was inert, *i.e.*, did not combine with the carbon. The carbons themselves were also subjected to processes for making them harder and more tenacious, and series of carbons were arranged to be brought into operation successively without opening the chamber. But one and all of these devices failed to secure stability in the carbon. A deterioration, variously described as a "disintegration," a "wearing away," a "kind of evaporation," was soon fatal to the life of the burner. The record abundantly established the proposition that, so far from turning to carbon for his burner, which was to have so high a ratio of resistance to radiating surface, one skilled in the art would have been led, by the teachings of that art, to suppose that its instability would prove fatal to its use irrespective of the size of the burner. Especially is it true, that the use of small carbons, in the attenuated or filamentary form, which Edison had indicated in the platinum patent, would not have been thought of. Nor do we find in the suggestions of Lane-Fox, either in his patents (British Nos. 3,988, 4,043, 4,626, of 1878, and 1,122 of 1879) or his other publications, any such appreciation of the cause of the disintegration of carbon, or any such proposed method of preventing it as would controvert the conclusion that the art was looking elsewhere than to carbon for the burner which should have a future. Certainly Lane-Fox himself seems to have looked for success rather to his metallic alloys and his compounds operated in nitrogen or other suitable gases than to carbon in a perfect vacuum. The literature of the art fully sustains the statement of Mr. Schwendler, quoted in the *Telegraphic Journal* in 1879 that "we can scarcely expect that the principle of incandescence will be made use of for practical illumination" unless there be discovered a conductor without the defects of platinum and "which does not combine at high temperatures with oxygen."

In June, 1878, and January, 1879 (U.S. patents 205, 144, and 211—262) Sawyer and Man indicated one of the causes which operated to produce this disintegration of the carbon, viz.: that "some oxygen or other element or compounds remain in the lamp," the carbon "occluding sufficient air or oxygen to render its consumption a mere question of time," as "the least quantity of oxygen in a sealed lamp is sufficient to combust an indefinite quantity of carbon." This they sought to remedy by heating the carbon pencils, immersed in a hydrocarbon liquid, to an extremely high temperature, thus producing a hard and dense carbon (and one whose specific resistance was lowered by that very process). They also, while the globe was on the pump and nitrogen flowing in and out of it, heated the "carbon to incandescence, thus driving out all the impurities and occluded gases, which are carried out of the lamp by the current of nitrogen." Believing that the deterioration of the carbon burner was due to the presence of occluded *oxygen* which escaped into the sealed chamber and promoted "combustion," they sought to secure stability by substituting for the oxygen they had forced out by heating on the pump, an atmosphere of nitrogen; that done, they sealed their chamber, which seems to have been a separable one.

Edison had experimented with carbon before he devised the platinum lamp of his French patent. Subsequently to the date of that patent, apparently because that lamp did not seem to promise the success he hoped for, he again turned to carbon. In the course of his investigations he made a discovery as to the cause of "disintegration," of which he availed himself, to devise a lamp in which carbon, even in the filamentary form required for a burner whose ratio of resistance to radiating surface was such as to apply the philosophy pointed out in his French patent, could be maintained for a sufficient length of time to become a commercial success.

The patent in suit set forth that theretofore "light by incandescence has been obtained from rods of carbon of 1 to 4 ohms resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon."

Edison's invention was practically made when he ascertained the heretofore unknown fact that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum, without the phenomenon of disintegration. This fact he utilised by the means which he has described, a lamp having a filamentary carbon burner in a nearly perfect vacuum.

It is true that the combination and manipulation, which secured a practically perfect vacuum by heating the burner while the exhaust pump was at work, and subsequently sealing the globe without introducing a foreign gas, is set out by Edison in his French patent as a means of effecting such a change in the condition of platinum as would permit of its being raised to higher temperatures, without rupture, cracking, or diminution of weight by volatilisation. But the evidence shows that the platinum lamp did not achieve success, and we think there was manifest invention in the substitution of carbon, freed from occluded gases, and placed in a nearly perfect vacuum.

Experts called for the defendant have testified that such change of material involved no invention, because the use, as a substitute for platinum of carbon of any size, operated in a vacuum, would be obvious to one skilled in the art. To this proposition we cannot assent. Sawyer and Man were skilled in the art, but, even after they

had learned how to force out the occluded gases and withdraw them from the lamp chamber, they turned away from the vacuum, thus ready to their hands, feeling no doubt that they were following the teachings of the art in seeking stability by the use, not of a vacuum, but of a nitrogen atmosphere. Edison was skilled in the art, but, after he had the nearly perfect vacuum of the French patent, secured against leaking by the all-glass globe of Geissler and Crookes, it was only after months of patient and persistent experiment that he found, in the substitution for his platinum of a filament of carbon, the success he had long sought for but not till then attained.

The second claim of the patent is broad enough in its phraseology to cover the invention above set forth—at least when the burner is a carbon *filament*.

The second claim may be paraphrased:—

The combination of carbon, filamentary or thread-like in size and properly carbonised, used as an illuminant in an incandescent electric lamp with a receiver made entirely of glass and conductors passing through the glass, and from which receivers the air is exhausted to such an extent that disintegration of the carbon due to the air-washing action of surrounding gases or to any other cause is so far reduced as to leave the carbon practically stable.

Defendant's lamps are plainly infringements of the second claim as thus construed:

Defendant further contends that the patent is invalid because it does not so describe the lamps as to enable a person skilled in the art at the date of the patent, to make a practically useful structure. The evidence of the witness Howell seems to us a conclusive answer to this contention.

The other defences interposed by defendant may be more briefly noticed.

The patent in suit was issued January 27th, 1880. A patent for the same invention was issued in Canada, November 17th, 1879, No. 10,654, the term of which expressed on its face was five years, but the Canadian Statute gave to the owner of the patent the right to an extension at his option, on the payment of a required fee, for the further period of 10 years. On May 4th, 1883, the owner paid the fee required, and on October 30th, 1883, obtained a certificate of extension.

In Bate Refrigerating Company *v.* Hammond, 129 U.S., 164, it was held that, so far as the term of a Canadian patent thus extended under the Canadian statute operated to curtail the term of a United States patent under section 4,887 U.S. Revised Statutes, it should be regarded as a continuous term for the entire period. It appears, however, that on March 5th, 1880, a patent for the same invention was granted in Sweden, the grantee of which subsequently failed to prove, as required by the law of that country, that the invention was "being constantly practised within the kingdom." Thereupon, on March 5th, 1883, the Swedish patent right was lost and forfeited. Defendant contends that in consequence, the Canadian patent expired on the same day, March 5th, 1883, or, if it continued till the expiration of the first five years expressed on its face, viz., November 17th, 1884, it could not, by the payment of fees, or the certificate of the Canadian Commissioner of Patents, be extended for the additional 10 years. For that reason defendant contends that the case at bar is distinguishable from Bate Refrigerating Company *v.* Hammond, and that the patent in suit expired with the Canadian patent, either on March 5th, 1883, or on November 17th, 1884, prior to the beginning of this action.

The Canadian Statute provides as follows:—

"An inventor shall not be entitled to a patent for his invention if a patent therefor in any other country shall have been in existence in such country more than 12 months prior to the application for such patent in Canada; and if during such 12 months any person shall have commenced to manufacture in Canada the article for which such patent is afterwards obtained, such person shall continue to have the right to manufacture and sell such article, notwithstanding such patent; and under any circumstances, *when a foreign patent exists, the Canadian patent shall expire at the earliest date at which any foreign patent for the same invention expires.*"

The soundness of the defendant's contention depends on the meaning under Canadian law of the phrase "when a foreign patent exists" as used in this statute. If that phrase is confined to foreign patents which exist before the relevant Canadian patent is issued, the loss and forfeiture of the Swedish patent right in no way affected the Canadian patent to Edison. The meaning of this phrase has not been declared by the Canadian Courts, but a careful examination of the evidence given by the Canadian lawyers who have testified as to its practical construction by the Canadian Government, and have given their professional opinions as to its meaning in Canadian law, satisfies us that it is there used as covering only foreign patents which exist before the issue of the relevant Canadian patent. We are of opinion, therefore, that neither directly (Pohl *v.* Anchor Company, 134 U.S., 381), nor indirectly through the Canadian patent, is the patent in suit affected by what happened to the Swedish patent.

The failure to limit the patent in suit on its face to a shorter term than 17 years, so as to expire at the same time with the prior foreign patent having the shortest term, does not affect its validity. Bate Refrigerating Company *v.* Hammond, 129 U.S., 151. Nor do we think that validity is in any way affected by the attempted certificate of correction. The patent, as originally issued, being in every respect a regularly executed document, and the statute providing for no subsequent alteration thereof by the Patent Office (except in cases of reissue, which this is not), the action of the Commissioner in endorsing it with an attempted "correction" was without jurisdiction and wholly void. And in the absence of any provision of law contemplating the surrender of an original patent by the grantee or holder (except for reissue) we cannot find, in the request to have such unauthorised correction made, any reason for holding that the patent was, by that act, surrendered.

The decree of the Circuit Court is therefore affirmed with costs.

THE DISSOCIATION OF ELECTROLYTES IN SOLUTION AS SHOWN BY COLORIMETRIC DETERMINATIONS.

Within recent years theories have been advanced by Kohlrausch, Ostwald and others, as to the state in which salts exist in solution, which at first sight appear to be startlingly contradictory to all previous ideas on the subject, and which might well be considered to revolutionise chemistry as a science. So numerous and so powerful are the arguments in favour of these theories, however, that in spite of many objections on the part of men of undoubted standing and capability as physical chemists, that many of the leading scientists of this and other countries do not doubt their validity.

In the expectation of being able to throw new light upon this interesting subject, over which so many battles royal have been waged during the last year or two, Mr. H. M. Vernon, B.A., has attacked it from a new standpoint, studying the dissociation of electrolytes in solution by making colorimetric determinations. The paper in which he expounds his method, describes his experiment and sums up his conclusions, has been published in the *Chemical News*, and may be consulted in this journal in full in the following numbers: No. 1,709, August 26th; No. 1,710, September 2nd; No. 1,712, September 16th; and No. 1,713, September 23rd. It will appear at once from these references that Mr. Vernon has not approached his subject in any *diletantte* spirit.

The argument with which this investigation is prefaced is as follows:—If a dilute solution of a coloured salt—as copper sulphate, for instance—contains less molecules of copper sulphate as such than a more concentrated solution, owing to the dissociation of the salt into its ions, Cu and SO_4, it follows, if no other influences are at work, that with equal quantities of salt present in each solution, the colour of the dilute solution must be lighter than in the more concentrated solution, and that, too, in proportion to the amounts of copper sulphate molecules dissociated into their ions. It is possible that the ions themselves of coloured salts may form coloured solutions, and so the colour of a dissociated salt may not be any different from that of the undissociated salt. [The probability of this being the case is discussed at length by Mr. Vernon.] If, however, experiment actually shows that dilute solutions of coloured salts are more than proportionately light in colour than concentrated solutions, there is a great probability that it is due to dissociation in solution.

To test this, Mr. Vernon compared solutions of some thirty-five coloured salts with each other colorimetrically at different dilutions. The influence of temperature on the colour effects of the different solutions were also determined. A modified method of colorimetry was used, being especially designed to meet the exigencies of the experiments which were undertaken.

The exhaustive paper in which this investigation is described is divided into three parts, viz.:—

1. The change of colour effect on dilution.
2. The influence of temperature on the colour effects of salt solution.
3. The relations of the colours of salts to one another.

The chief results arrived at under these respective subdivisions are as follows:—

1. Almost all the solutions of the thirty-five coloured salts examined show considerable decrease in colour effect on dilution, due in all probability to dissociation taking place. The only exceptions are certain chromium derivatives, the colour of whose solutions, on gradual dilution, either remain constant or increases slightly. When their solutions are suddenly diluted, different colour values are obtained. Potassium permanganate solution only shows a very slight decrease in colour on dilution. Taken as a whole, ferric salts show the greatest decrease in colour effect on dilution of their solutions; then cobalt salts, then uranium salts, and then nickel and cupric salts. Generally, also, organic salts show the most decrease in colour on dilution, chlorides less, nitrates still less, and sulphates the least.

2. All solutions of salts, with the exception of those of certain chromium derivatives, and, perhaps, of potassium permanganate, increase considerably in colour effect upon being heated. The amount of colour effect depends on:—

(*a*) The nature of the base of the salt, ferric salt solutions being most affected by temperature, then those of cobalt and uranium, and then those of copper and nickel.

(*b*) On the nature of the acid radicle, chlorides being most affected, nitrates next, and sulphates least.

(*c*) On the degree of dilution of the solution, sulphates being most affected in their decinormal solutions, and least in their centinormal, whilst chlorides are most affected in their normal solutions, and least in their centinormal.

3. On comparing solutions of different salts together as to colour effect, the values obtained bear considerable resemblance to the amounts of decrease of colour the solutions undergo upon dilution, organic salts possessing the greatest colour effect, chlorides a less effect, sulphates and nitrates a still smaller colour effect.

From the review of the results obtained, Mr. Vernon comes to the conclusion that those obtained for the effect of temperature on the colours of salt solutions, are, without exception, in favour of the hydrate theory of the nature of solution, and that the results, as a whole, indicate that dissociation takes place on the one hand, and hydrates are formed on the other; whence it would seem that salts exist in solution in both these conditions at the same time.

This paper will doubtless have to bear much criticism from the hands of the opponents of the dissociation theory, and we shall be interested to see Mr. Vernon "stand to his guns," for he appears to hope that the results of his investigation may be considered seriously as "still another" proof of the validity of the revolutionising theory.

NOTES.

New Cable Line in Baltimore.—This installation is of special interest, since the power station is built in what was once a church with vaulted arches and a stately steeple. The American contractors have built a boiler house beside the late church, carrying out the architectural details in keeping with it. In the church two engines of 1,000 nominal H.P. each, the cable drums and tightening gear have been installed. Churches have been put to curious uses before. History says that Napoleon Bonaparte stabled his horses in the Cathedral of Cologne, but we think this is the first church to be converted into a power station. As the *Street Railway Review* facetiously puts it, "this church has more power than any other in the world." We wonder what the United Methodists, who originally built the edifice, think of its present use.

"Sigma" on Psychology.—For boldness and originality Mr. John T. Sprague has, over the *nom de plume* "Sigma," acquired a considerable reputation amongst the readers of the *English Mechanic*. He will not take it other than as a compliment, we think, if we also allude to his iconoclastic propensities. For some years he has been a consistent, if not altogether coherent opponent, of what he terms "the doctrines based upon the fancied properties of the ether." Mrs. Besant's recent articles anent mesmerism and hypnotism have inspired Mr. Sprague to commence a series on "Psychology," in the same paper. The introduction to these articles is in excellent temper. We are entirely "at one" with him when he asserts that the scientific metaphysician ought never to become a metaphysical scientist. He may rightly enough use his imagination in considering the nature of matter, and what conceivable properties of ether, &c., may assist him in forming a conception of the nature of existence; but he has no right to carry his imaginings into scientific explanations, and treat *guesses* under the name of *hypotheses*, as knowledge. We are thankful that, in dealing with this subject, he does not propose to range over all the ideas and asserted facts which may be found in ancient writings. In the correspondence columns of the *English Mechanic*, Mr. S. Bottone, by his sketch of Paracelsus (of whom we heard not a little in Mrs. Besant's recent articles), has shown us that it is better to take such worthies and their writings *cum grano salis*. Mr. Sprague's articles promise to be of exceptional interest to the theosophists; they may, perhaps, take rebuke from one who is apparently sympathetic towards at least one of their much cherished isms.

Electric Lighting of Belfast.—The Belfast Corporation have adopted the recommendations of the Electric Lighting Committee to appoint an expert electrician to advise as to the best electric lighting system, and the best method of procedure. The committee consider that the time has come when an installation capable of supplying, say, 10,000 incandescent lights—or more, if future extension is found desirable—should be undertaken. The *Belfast Evening Telegraph*, under the heading, "The Lighting of Belfast," is giving a series of articles on electrical matters in general.

The Leonard Three-Wire System.—An interesting reference is made to the cost of the Leonard and the Edison three-wire systems in the last number of the *Electrical Engineer* of New York. It appears that the prime cost of the two methods is identical from the switchboard to the lamps inclusive; the difference appearing only in the generating plant. The Edison system necessitates two dynamos of the same voltage as the lamps, with the neutral wire connected between them. In the Leonard method one large dynamo, of twice the potential of the lamps, is coupled to the outside mains, and the neutral wire is not in immediate contact with it. But a small compensating dynamo, capable of giving the difference of output between the two circuits, is coupled to the neutral wire and to one of the outer mains. This machine will run sometimes as a generator and sometimes as a motor, according to the preponderance of load on one side or other of the system. Its field is wound for the full potential, and is excited in shunt from the outer mains. The large dynamo is also shunt wound, and therefore an adjustment of its field rheostat increases the E.M.F. of both dynamos; and thus the P.D. on both sides is varied by one rheostat. This considerably lessens the difficulty of regulating the E.M.F. And further since the number of large dynamos is reduced by one-half, the difficulties arising from bearings, commutators, and brushes is practically halved; for the compensating dynamos cause very little trouble, since they are generally running with only small loads. The first central station to be installed on the Leonard system is at Charlestown, W. Va. The plant is a small one, with about 750 lamps, and the station is located about three-quarters of a mile from the nearest lighting. The cost of wiring on the two-wire system would have been about $8,000, and on the three-wire plan has only cost $2,500, or a net gain of $5,500. The large dynamo has an output of 40 kw., and the compensating machine, 2½ kw.

The Lowest Tender.—Under this heading *The Engineer* discusses the general question of what are the rights and wrongs in the methods of asking for and dealing with tenders for work of all kinds. There can be little doubt but that the very indefinite way in which tenders are dealt with is not at all satisfactory. The worst cases are, perhaps, those in which a firm is practically selected, and then tenders are issued for the purpose of putting on an appearance of impartiality; that this is done, we believe is a fact. The idea that the acceptation of the lowest tender is the general and understood practice is, we think, hardly very general at the present day; that the lowest tender would be accepted, provided all the conditions are satisfactory, is, of course, the fairest line to follow. To accept a tender when it is obvious that good work cannot possibly be put in at the price is not a business way of proceeding; if the contractee does accept such a tender, then it may mean endless trouble and expense to him to see that the conditions of the contract are carried out, and, perhaps, after all the contractor may find that he cannot carry out the work, and the whole matter may have to be commenced anew. On the other hand, it is not necessarily to be concluded, except in the case of a very heavy contract, that an obviously unremunerative price has been put in through error on the part of the contractor; the latter may find it to his advantage to put in a low price in order to obtain the work for advertisement purposes. The fact is that no definite rule can be laid down in the matter, the whole question has to be judged by the circumstances of the case; it would be as well, however, that a distinct statement should always be made to the effect that the lowest tender will not necessarily be accepted. Once lay down the rule that the lowest tender will be accepted, and innumerable troubles are almost certain to arise; indeed, the very common reservation proves this.

Electric Lighting Provisional Orders.—At the last meeting of the Willesden Local Board, the Works Committee advised the postponement until May of the application of the board for a provisional order. Mr. Luke said that the application ought not to be deferred, as the order would have to be obtained at some time. The expense would not be much, and the order would be a check on the gas company. Mr. Smith said the board ought not to barter money away to get an order, for it was not consistent for members of the board to take the electric lighting of the parish. He wanted to know if Kilburn was to have the light, why not Harlesden and other places? The committee's recommendation was lost.

The Hackney District Board of Works have decided to apply to the Board of Trade for a provisional order for the public supply of electric light and power in their district.

Car Starting by Telephone.—The difficulty of maintaining schedule time with a large number of cars is well recognised; and on many lines if a car be delayed by an accident for a quarter of an hour or 20 minutes, the whole line would be so deranged that schedule time will not be overtaken during the whole of the day. In Denver where there are 74 miles of electric and 13 miles of cable tracks, requiring about 103 trains in daily operation, this is especially important. It was found that a breakdown of any kind on the road inevitably disorganised the traffic, since the making up of time rested chiefly with the conductors. To obviate this a system of telephone circuits has been arranged with various call points all communicating with the head office. Every conductor on arriving at the terminus of his route immediately reports to headquarters the number of his car, and receives in reply his proper leaving time and any instructions that may be necessary. The dispatch clerk is thus advised of the whereabouts of each car, and is often able to fill up a space of from 30 to 60 minutes caused by a "parade." Of course it is impossible for one car to jump another by the cable or electric systems, and hence the proper control of the cars is of more importance than with horse service. As a set off against the expense of the telephones may be taken the saving of starters at the various termini. The telephones are estimated by the Denver Company to give a saving of at least 80 per cent. over the cost of the old system.

The New Telegraph Convention between Russia and China.—As already announced, says the *Times*, a new telegraph convention between Russia and China has been signed at Pekin by the Russian Minister and the head of the Chinese Telegraph Administration, and now only awaits ratification by the respective Governments. The details of this convention have been brought by this week's mail from China. It is styled, "Treaty between China and Russia for the connection of telegraph lines on their frontier," and sets out that whereas it is intended to establish telegraphic connection between the two countries, it is agreed the points of junction are to be Hunchun-Possiette, Helampo-Blagoveschensk, and Kiachta. The tariff, which to the rest of the world is the important part of the convention, provides that Russia is to receive 1·73 fr. per word on all messages between Asiatic Russia and China, 2·73 fr. on messages to and from European Russia and China, and 3 fr. on messages in transit, while China receives 2 fr. on all messages from any part of Russia and 5·50 fr. on messages from any other European country, out of which she is to pay the proportion due to the European country or countries over whose wires the message passes, in accordance with the rules of the Telegraphic Union. Where the Danish and British cable companies (the Great Northern and the Eastern Extension Companies) have stations, the rates charged by the Chinese lines shall not be less than those now charged by the Great Northern Company; but if the companies reduce their rates, the Chinese Administration may do the same. The treaty is to last until December 31st, 1892. By this arrangement messages between China and Asiatic Russia cost only 3·73 fr., and between China and European Russia 4·73 fr., while the rest of Europe will pay 8·50 fr. The treaty, it must be remembered, has still to get the ratification of the Chinese Government. By the foreign mercantile communities in China it is regarded as hostile to their interests, for its effect will be to maintain the present very high rate for messages between China and Europe.

Institution of Electrical Engineers' Dinner.—The annual dinner of the Institution of Electrical Engineers is to take place at the Criterion Restaurant on November 18th. We are glad to hear that the speeches are to be kept short, and, at a comparatively early hour, those present will adjourn to the smoking room to be musically entertained, and to leisurely engage in conversation with their friends.

Coast Communication.—According to the *Dover Standard*, Mr. E. J. Hobbs, of Ramsgate, the promoter of the scheme for telegraphic communication between lightship and the shore, states that he is officially informed that the report of the Royal Commission, which will be presented after the meeting on the 19th inst., will recommend that the Goodwin Lightships be, telegraphically and telephonically, connected with the shore, the East Goodwin Lightship being connected with Dover. The work will be carried out by Lucus's patent. A system of telephonic communication on shore is also being rapidly pushed forward on the South East Coast. At Ramsgate and Margate some of the wires are already laid in connection with the Coastguard stations, and arrangements are being made to connect various points to the North Foreland on the one side, and Deal on the other, while similar arrangements are to be made at Hythe and New Romney, so that the dangerous coast line between the North Foreland and Dungeness will soon be provided with a ready means of inter-communication.

The Telephone in France.—The Administration of Posts and Telegraphs, which a short time ago took over the telephones in France, has just published a very interesting report, according to which there are now 112 towns in France provided with telephone communication. These towns, says the *Times*, represent a population of over six millions, this being nearly a sixth of the total population of France. When the State took over the telephones, there were only 11,440 subscribers, whereas there are now 18,191, rather more than half of whom are in Paris. But while this gives a proportion of only one subscriber to 253 inhabitants, there are several other towns in which the proportion of subscribers is much higher, being one in 215 at Mentone and one in 120 at Cannes, and in several of the large industrial towns of the north there are also relatively more subscribers than in Paris. The total received from subscribers for the past year was £210,960, of which nearly two-thirds was derived from Paris.

The Telephone System in Switzerland.—The Geneva correspondent of the *Economiste Français* states that the increase in the number of telephone lines since the new tariff came into operation, about two years ago, has been very remarkable. Previous to that, there were 61 telephone lines, with 6,944 speaking stations and a revenue of about £44,000, the annual subscription being £6, with no limit to the number of conversations. The new tariff lowered the subscription to £3 4s. (80 f.), and the result is that at the beginning of the present year there were 101 telephone lines, with 12,595 speaking stations, this being equivalent to an increase of 81 per cent. The length of lines is 3,225 miles, while there are 13,340 miles of wires, the principal lines being those of Geneva (2,176 stations), Zurich (1,712), Basle (1,522), Lausanne (806), Berne (753), and St. Gall (596). The total number of messages between residents in the same town was 6¾ millions, while there were 687,000 conversations exchanged between different places. The new law stipulates that each subscriber shall be entitled to only 800 conversations in the course of the year, and pay a halfpenny for each one over that number, but over 78 per cent. of the subscribers kept within the prescribed limits. Although, says the *Times*, the total receipts amounted to £65,000, the expenses incurrred in putting down new lines and increasing the staff were so great that the net receipts were about 4 per cent. less than in the year previous to the passing of the new law, but for all that the profit derived by the State is so large that these expenses will soon be paid off, and a surplus will soon be available. The development of telephone communication has, as might be expected, checked the increase in telegraphic communication, the number of telegrams showing only a fractional increase upon those of the previous year, while it is anticipated that there will this year be an actual decrease.

North Kensington and Electric Lighting.—It is stated that complaints have been made by residents in North Kensington with respect to the non-supply of current by the House-to-House Electric Lighting Company within this area. The Works Committee of the Kensington Vestry are to consider what can be done to compel the company to lay mains in the district in question.

The Popp Company at Paris.—We do not know what will become of the Popp Company at Paris. This company is divided into two departments, both of which were directed by M. Popp—the Compressed Air Company, and the Electrical Sector Company. In consequence of dissensions, M. Popp resigned the direction of the Compressed Air Company, and was succeeded by Baron de Pfeffel, who was chosen as director (administrateur délégué) by the Council of Administration; but it seems he retains his position as manager of the Electrical Company. We should not be surprised if the company formed by distribution by compressed air were soon to disappear. Their books do not show very great success. The balance-sheet for 1891 shows a loss of 402,418 francs. Moreover, the works at the Lake St. Faylan, which served for the distribution by compressed air, are being completely transformed. Half the compressors have been replaced by dynamos, so as to form electrical works similar to the Richard-Lenoir Boulevard works.

The Constants of Incandescence Lamps.—M. Ch. Haubtmann has just published a long article in *L'Electricien*, in which he shows the results of the long experiments performed by him on various types of incandescence lamps. These lamps worked at differences of potential of 102 and 110 volts. He measured the luminous power and the specific consumption in watts per candle after 250, 500, 750 and 1,000 hours' lighting. All these results are set down in tables and curves. We may sum them up as follows:—The lamps belonging to the Compagnie Française (16 candles) have at first a luminous power of 15 candles, which fall to 5 candles after 1,000 hours. The mean specific consumption in watts per candle is 2·8; it varies from single to double, and even more. This remark, moreover, applies to all the lamps. Ten-candle lamps give 10·47 candles at first and 5·2 after 1,000 hours, with a mean consumption of 3·6 watts per candle. The Siemens lamps give 19·8 candles at first and 11·3 after 1,000 hours with a mean expenditure of 3·8 watts per candle. For the Gabriel 16 and 10-candle lamps, under the same conditions, the luminous powers vary from 18 to 15 and from 13·5 to 8·56 candles with respective mean consumptions of 3·9 and 4·1 watts per candle. The Swan-Edison lamps (French manufacture) have luminous powers of 18 candles when started and 13 after 1,000 hours, with a mean consumption of 4·18 watts per candle. The Swan-Edison lamps (English manufacture) only vary from 18·4 to 13·9 candles with a mean expenditure of 3·7 watts per candle. The Khotinsky lamps fall from 16·5 candles at starting to 13 after 1,000 hours with a mean expenditure of 3·9 watts per candle. The results for Cruto lamps are:—16·4 candles at starting, 11 candles after 1,000 hours; expenditure 3·7 watts per candle. The Allgemeine Gesellschaft, 16 and 10 candle lamps, and those of the Société Hongroise and the Société de Zurich, are characterised by the following figures:—

	Lighting powers, in candles.		Mean consumption in watts per candle.
	At starting.	After 1,000 hours.	
Algemeine Gesellschaft—			
16 candles	15	8·8	3·12
10 „	10	5	3·47
Société Hongroise—			
16 candles	21	13·25	3·8
Société de Zurich—			
16 candles	17·6	7·35	2·8
10 „	12·92	9·7	3·3

The results of this study are very remarkable, and show how different are the conditions of working in different types of lamps.

Darkness on the Paris Boulevards.—For the occasion of the *fête* of September 22nd at Paris, in order to allow the chariots belonging to the historical procession to pass, it was necessary to remove the lamp-posts which are placed in the middle of the road and which bear the arc lamps used for street lighting. Gas lamps of great intensity were lighted along the Boulevards which were, however, plunged in comparative darkness; complaints were heard on every side. People accustomed to a brilliant light cannot put up with gas-lamps.

Electric Traction at Wednesbury.—Under the direction of Mr. Alfred Dickenson, C.E., the general manager of the South Staffordshire Tramway Company, the arrangements made about 12 months' ago for the introduction of the overhead wire system of electric traction on their lines between Wednesbury, The Pleck, and Walsall, and Bloxwich, The Pleck, James Bridge, and Darlaston, will be completed in a fortnight or three weeks. It is proposed to run 14 cars, and the seats both inside and out will be similar to those in railway carriages, instead of being placed longitudinally, as in the cars now in use. They will, however, seat 40 passengers. They will be illuminated at night with the electric light. It is anticipated that towards Christmas the service will be greatly increased, and also that the new system will shortly be adopted on the company's other lines.

Water Power in the West of England.—It is reported, says the *Shrewsbury Chronicle*, that the Severn Conservators offer no opposition to the proposal to utilise the water-power at Diglis Weir for electric lighting purposes, but it appears that the engineer to the Severn Commissioners can give no such assurance. The Commissioners would not consent to anything reducing the flow of water over the Weir to less than 6 inches, and the consent they might give to the use of the water over the Weir to less than 6 inches, and the consent they might give to the use of the water above that level must be subject to the right to utilise the water-power when they wished. The sub-committee replied that the Council did not admit the Commissioners' right to impose such a condition. It was suggested as an alternative that they acquire Powick Mills, which were offered to let on a 99 years' lease at £160 per annum, or for sale for £5,000, the present owner agrees, in either case, to maintain the weir and require the electric light for himself and tenants at Wick at the same rate as the citizens. The surveyor was directed to report on the power likely to be derived at Powick, and the possibility of navigating the Teme up to Powick.

The Central Institution.—Of the 109 candidates who recently entered for the Matriculation Examination at the Central Institution, Exhibition Road, 73 passed, and six did sufficiently well to be allowed to join the College as unmatriculated regular students. In addition to these 79 thus admitted, each to attend courses in all the four departments of mathematics and mechanics, engineering, physics and chemistry, and those who having been admitted in previous years, have not yet completed their course, some 40 special students have joined the advanced courses in one or more of these departments, thus bringing the total number of students at the Central Institution up to the maximum for which it was attended. On the result of this Entrance Examination, the Clothworker's Scholarship of £60 a year, with free education for two years, and renewable for a third, was gained by W. G. Bennett, from the Bancroft School; the Mitchell Scholarship of £30 a year for two years, with free education, by E. W. Hummel, from the Finsbury Technical College; the Clothworker's Technical Scholarship of £25 a year for two years at the Finsbury College, and £30 a year for three years at the Central Institution, both with free education, by W. C. Maers; and four Institute's Scholarships of sufficient value to cover the fees for three years, by M. J. P. O'Gorman, from the Royal University, Dublin; W. T. Gidden, Bancroft School, and A. D. Constable and W. A. Davis, both from St. Dunstan's College, Catford. At the end of the last session the John Samuel Scholarship of £30, and free education for a third year's student, was awarded to H. C. Leake, and the Siemens Medal to C. V. Drysdale.

The Production of Chlorine and Alkaline Carbonates by Electrolysis.—Several improvements in commercial electrolysis have already been credited to C. Kellner, of Vienna, and now he has developed another which involves some rather important modifications of principle, as well as of detail. He can produce chlorine gas and alkaline carbonates simultaneously from a heated solution of an alkaline chloride. This solution is caused to rapidly circulate in two separate streams through an electrolytic decomposing apparatus. One stream is conducted past the anodes, and is mixed with a small quantity of sulphuric acid, or of a sulphate of the chloride base, and this stream after leaving the anodes is conducted through a vessel containing fresh solid alkaline chloride, whereby the liquid is again completely saturated before returning to the anodes. The other stream is conducted past the cathodes of the apparatus, and then is cooled in contact with more solid alkaline chloride, whilst at the same time it is subjected to the action of carbonic acid gas, whereby a carbonate of the alkali present is formed and precipitated from the solution, the latter being afterwards conveyed back to the cathode cells again. To facilitate the escape of the hydrogen which is set free, carbonic acid is introduced into the cathode cells. The electrolyte is also maintained at such a velocity and temperature as will prevent carbonates from settling within the decomposing apparatus. There is a curious arrangement of diaphragms set in frames and connected by passages through which the electrolytes circulate and the liberated gases escape. These diaphragms are made of a permeable fabric, or of porous clay, the pores of which are filled with a gelatinous material mixed with a solution of salt corresponding to that to be decomposed. This prevents injurious mechanical diffusion from one cell to another of the liquids treated, and is said also to facilitate the circulation of the ions. The electrodes are made by mixing together powdered retort carbon and a thickened solution of wood cellulose in zinc chloride; this mixture is kneaded to a paste, washed, moulded, and then heated in a muffle, impregnated with a hydrocarbon, and then heated again; the latter process being repeated several times. Kellner also uses electrodes, the pores of which are filled with peroxide of lead, obtained either by covering them with a layer of litharge and ammonium sulphate mixed, or by boiling them in a saturated solution of lead acetate, and afterwards electrolytically transforming the deposit into peroxide of lead.

Londonderry Electric Lighting.—The electric light may be expected in Londonderry ere long. Steps are being taken to put the provisional order into operation.

Cost of Harwich Provisional Order.—There seems to have been much discussion at a meeting of the Harwich Town Council last week. A motion was proposed passing the accounts, which included £318 7s. 3d., costs in connection with the electric lighting provisional order. A member gave notice that at the Council's next meeting he would propose a vote of censure on those who had agreed to the expenditure of the sum.

Queensferry Electric Lighting.—For some time the proposal to purchase the gas works has been before the Queensferry Town Council. It is now thought that there is sufficient water power to enable the corporation to introduce electric lighting as cheaply as gas, and it has been decided to appoint an expert to enquire into the matter.

Spark Experiments with Samarium.—Some curious experiments have recently been performed by M. L. de Boisbaudran, who allowed an electric spark from a coil with a long wire to play upon the surface of solutions containing samarium. Three lines were seen in the spectrum under these conditions, viz.: λ 466·2, λ 462·7, and λ 459·3; but when the current was reversed a band appeared at λ 611—622. This band appeared to gain in brilliancy where the spark was made to impinge on the centre of the surface of the liquid, instead of at the side; and the other bands showed marked differences in intensity when the point of impact of the spark on the liquid was altered. It is possible that there may be a relation between the band 611—622 and the narrow band observed by Crookes in mixtures of basic yttrium and samarium sulphates.

Personal.—We have received the following from Mr. H. Newman Lawrence:—"I see, with great regret, that my former colleague and collaborateur in various communications to the Institution of Electrical Engineers and other scientific societies, Dr. Arthur Harries, has issued a report upon the electropathic belts of Mr. Harness, in which he eulogises those appliances. I must therefore ask you to be kind enough to allow me to make known through your columns that my connection with Dr. Harries ceased about 12 months ago."

Private Electric Lighting.—The electric light has been introduced into the large warehouses of Messrs. Wylie and Lochhead, of Buchanan Street, Glasgow.

St. James's and Pall Mall Company's New Station.—We understand that the Electrical Power Storage Company, Limited, have secured a contract for storage batteries for the St. James and Pall Mall Electric Light Company's new station in Carnaby Street.

A Clergyman in the Field.—It is interesting to notice that a series of scientific articles are being written for the *Freeman's Journal* by the Right Rev. Monsignor Molloy, rector of the Catholic University. Some years ago he wrote on electric lighting, now he does his best at describing an electric railway in France.

Electric Construction Corporation.—We notice that the quotation of this company's shares is now advancing. On Wednesday last week they were $3\frac{3}{4}$ to $4\frac{1}{4}$. On Wednesday, this week, they were quoted at $4\frac{1}{2}$—5.

Central Stations in France.—We understand that the central station for the town of Saint-Jean-de-Fos will be formally inaugurated at the end of this month or the beginning of next.

Lancashire Co-operative Societies and Electric Lighting.—The co-operative societies in Lancashire are taking up the question of electric lighting, and in the case of the Bolton Society it has already been introduced. Two other societies, Accrington and Farnworth, are adopting schemes of electric lighting. The new light is found to be of great advantage in more ways than one in the several departments of the Bolton Co-operative Society, and the movement is likely to become a general one with Lancashire co-operative societies.

Colour and Electrolytic Dissociation.—A short time ago Knoblauch made an interesting series of experiments on the absorption spectra of coloured salts, and came to the conclusion that his results were in disaccord with the electrolytic dissociation hypothesis. Amongst other deductions, he concluded that on varying the degree of concentration of the coloured salt solution no change in the absorption spectrum occurred, and this, if true, would afford strong grounds for his general statement; but it seems that he omitted to make proper photometric measurements, and the spectra were simply compared by the eye—a not altogether infallible testing instrument, unfortunately. Since, however, the most concentrated solutions used by him contained a salt in a considerably dissociated condition, a mere inspection of the absorption spectra could not be expected to afford any criterion of the progress of dissociation as the solution became more dilute. This cuts away all the ground upon which his deduction—that the results are antagonistic to the dissociation hypothesis—is based. G. Magnanini has recently measured the extinctions for solutions of various coloured salts, reducing the electrolytic dissociation of the dissolved salt, by adding to the solution a colourless salt or free acid having one ion in common with the coloured salt. Thus, to solutions of sulphate of copper were added considerable proportions of sulphuric acid and sulphate of soda. The coefficients of extinction in this, and in similar cases, were found to be quite unaltered by the diminution of electrolytic dissociation. Magnanini criticises the whole of Knoblauch's deductions unfavourably, and concludes that for the salts which he examined, namely, the nitrate and sulphate of copper, the sulphate of nickel and permanganate of potash, the colour of the aqueous solution is quite independent of the electrolytic dissociation.

That Prosperous Undertaking!—Last week we made some short comments regarding the accounts of the Petroleum Engine Company. The ordinary general meeting was held on Wednesday last at the offices of the company, 23, Queen Victoria Street, Mr. Henry Pawson presiding. Notwithstanding the fact that Mr. Stovin (who claims to be the largest shareholder) and several others did their utmost to get our representative admitted, the directors absolutely declined to allow him or any other member of the Press to be present. Mr. Stovin informs us that a few days before the meeting, he understood it would be open to the Press; but at the last moment it seems the directors withdrew their consent. It may be remembered, by those interested, that last year our reporter was excluded; yet at the meeting the chairman remarked, on being asked the question, that it was not the fault of the company if reporters did not attend the meeting. We would couple this action of the directors with our criticism of last week, and leave our readers to draw their own conclusions.

Annual Soirée of the Windsor and Eton Electrical Society.—The Windsor and Eton Scientific Society propose holding their Annual Soirée in conjunction with the inauguration of the electric lighting of the Royal Borough. The ceremony will take place in December, and it is intended that the chief feature of the evening shall be an exhibition of electrical and magnetic apparatus. Persons wishing to exhibit should apply for particulars to Dr. J. W. Gooch, 9, High Street, Windsor.

St. James's and Pall Mall Electric Light Company.—The electric current sold for the quarter ending September 30th amounted to £5,763, as against £5,279 for the corresponding period of last year.

"Magnetic and Electric Fields."—On Monday last, the 17th inst., Prof. Silvanus Thompson delivered a lecture on this subject in the Town Hall, Manchester, in connection with the Technical Instruction Committee.

Electric Light in Vienna Cathedral.—On Sunday afternoon last St. Stephen's, the famous Cathedral of Vienna, was, for the first time, lighted by electricity. A trial of the new light was made on Saturday, in the presence of Cardinal-Archbishop Gruscha, and proved very successful. Twelve arc lamps, each of 1,000 candle-power, are distributed over the church, four in each of the three naves.

Fatal Accident.—James Rinney, of Crewe, who had been engaged in renewing the electric lamps at Holyhead Railway Station, was killed last Friday by falling from one of the pillars, a distance of 14 feet.

Old Students' Association.—The annual dinner of the Old Students' Association will be held on Friday, October 28th, 1892, at 7.30 p.m., at the Holborn Restaurant. The reception by the President will begin at 7 p.m.

Bolton and Electric Light.—The Bolton Corporation have recently been investigating the question of electric lighting, and it has now been decided that the town shall be supplied with the electric light. The system adopted is to be also capable of running the trams, which will probably be taken over by the Corporation at the expiration of the lease next year.

Bristol Electric Lighting.—After months of delay, consequent upon the difficulty experienced in constructing the foundations, the Electrical Committee of the Bristol Town Council, says the *Western Daily Press*, have found themselves in a position to invite tenders for the Central Electric Lighting Station, the plans for which were prepared last year by Mr. Henry Williams, architect to the committee. About eight tradesmen sent in tenders, including Messrs. J. E. Davis, Messrs. Durnford & Son, Mr. G. Humphreys, Messrs. Wilkins, Mr. Krauss, Mr. W. H. Cowlin, and Mr. C. A. Hayes. The committee attached importance to the time in which the work could be performed, and it is understood that, subject to certain requirements being complied with, the tender of Mr. Hayes, at £13,000 odd, will be accepted.

Royal Commission on Coast Communication.—The Royal Commission upon electric communication with lighthouses and lightships resumed its meetings on October 19th and 20th, when they were to take the following evidence:—On the 19th, from the masters of the following lightships: North Hasboro', near Cromer; Woold Cross-sand, Shipwash; Kentish Knock, North and East Goodwin. On the 20th, evidence from Capt. Halpin, Mr. Bedwell, and Mr. Willoughby Smith, of the Telegraph Construction and Maintenance Company, and from the coastguard officers of Aldworth, Swanage, and the Isle of Wight.

New Theory of Accumulators.—According to the *Bulletin Internationale de l'Electricite* M. Bidard, Professor of Chemistry at Rouen, has expounded a new theory of electric accumulators.

Telephone between New York and Chicago.—A Reuter's telegram, dated New York, October 18th, reads as follows:—"Telephonic communication was successfully opened to-day between New York and Chicago, and a number of messages were exchanged between the two cities. This line, which is considerably the largest that has ever been used with favourable results, is nearly 950 miles in length. The operator at the Chicago end of the wire assured the New York operator that he could hear his voice as distinctly as though he was standing close by him."

NEW COMPANY REGISTERED.

Elieson Accumulator (British Patent) Syndicate, Limited.—Capital £12,000, in £1 shares. Objects: To acquire from C. P. Elieson certain patent rights relating to improvements in electric accumulators in accordance with an agreement, particulars of which are not given; generally to carry on business as manufacturers of and dealers in electrical appliances and apparatus of every description. Signatories (with 1 share each), R. R. Hutchinson, Pear Tree House, Fulham Road, South Kensington, S.W.; W. Smith, 6, Great Winchester Street, E.C., and C. Smith (same address); E. W. Spendlow, 33, South Fields Road, Wandsworth, S.W.; G. S. Ridley, 6, Great Winchester Street, E.C.; H. Davies, 3, Platt's Lane, N.W.; S. W. Smith, 6, Great Winchester Street, E.C. The number of directors is not to be less than three, nor more than seven, the first being the signatories to the memorandum of association. Qualification, £500. Remuneration to be fixed by the company in general meeting. Registered on the 13th inst. by Mr. A. Caillet, 6, Great Winchester Street, E.C. Registered office, 6, Great Winchester Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Installation Company, Limited.—The statutory return of this company, made up to August 25th last, was filed on the 31st of the same month. The nominal capital of the company is £18,000, divided into 18,000 shares of £1 each, all of which have been taken up; 3s. 4d. has been called up on each of the shares, and all calls (£300) have been paid. Registered office, 64, Victoria Street, S.W.

Hanley Electricity Supply Company, Limited.—From a document which has been filed at Somerset House, it appears that this company has been dissolved, the liabilities being nil, and all expenses having been borne by the Brush Company.

BUSINESS NOTICES, &c.

The Electric Light in Canning Town.—Gradually all the suburbs are adopting this method of lighting, notably Brixton, Deptford, Holloway, &c. We now learn that its adoption is progressing in Canning Town, where Messrs. Vaughan & Brown, of Kirby Street, E.C., have fitted up an installation in the Albert Music Hall.

The Electric Light in the City.—Quite a number of new electric lighting contracts are to be noted since our last report on the progress of lighting in the City. Among the new work in hand, we may mention that Messrs. McClellan & Co. are fitting up the premises of Messrs. Dolland, opticians, Ludgate Hill. Some premises at 4, Union Court, Old Broad Street, are being fitted up by the Brush Electrical Engineering Company. The latter company are also engaged on work at 8 and 9, Old Jewry. The London and Provincial Bank in Lothbury is being fitted up by Messrs. J. G. Statter & Co. Messrs. Frank Suter & Co. are busy on the premises of Messrs. L. Phillips & Co., furriers, 53, Newgate Street, while Messrs. H. F. Joel and Co., are fitting up 7 and 9, St. Bride Street. The extensive contract of the Smithfield Market lighting, which is in the hands of Mr. Julius Sax, of Ridgmount Street, W.C., is approaching completion and will shortly be officially inaugurated. Messrs. Drake & Gorham, of Westminster, are fitting up the premises of Messrs. John Dickinson and Co., Old Bailey. Good progress is also being made as regards street lighting, several further streets being now illuminated in this way, notably St. Andrew Street, St. Bride Street, Farringdon Street and New Bridge Street, while the necessary posts are being erected in Holborn. Messrs. Miller & Woods are doing fitting work at 52, Mansion House Chambers.

Electrical Exhibits at the Kimberley Exhibition.—At the Kimberley Exhibition, which was opened recently at Kimberley, South Africa, there are several interesting electrical exhibits, among which is a search light by Messrs. Mather & Platt, of Manchester, which firm has carried out the electric lighting of the exhibition. Messrs. J. G. Statter & Co., of Victoria Street, Westminster, exhibits, amongst other objects, a dynamo giving 80 volts at 100 ampères, mine fittings and fountain lights. Messrs. Woodhouse and Rawson have a large exhibit of their productions. Messrs. Edlin and Stevenson, of Capetown, show two motors, one driving a sewing machine and one a diamond cutting machine. This firm are also the agents for Messrs. Johnson & Phillips and the General Electric Company, the production of both firms being exhibited. The former comprises Kapp dynamos, Kapp transformers, "D.P." storage batteries, &c., while the latter includes a good show of small motors, &c. Messrs. Gibson Bros., a local firm, exhibit an accumulator for electric cars.

Electric Lighting in the Highlands. — A large amount of installation work is in hand in the Highlands of Scotland. Mr. R. Frederick Yorke, who carried out the electric lighting at Scatwell, has completed very recently many other houses in Inverness-shire, with very satisfactory results. The first of these was at Achnacarry, for Lochiel. The satisfactory results of this installation led to other work in the neighbourhood, and the late Lord Abinger decided to introduce electric lighting into Inverlochy Castle. Mr. Yorke has also carried out the lighting at Inverie House, for Mr. John Baird, of Knoydart. At Carrimony, Mr. L. A. Macpherson decided also to adopt electric lighting, and although 24 firms applied, the work was entrusted to Mr. Yorke, and was entirely satisfactory. Another contract has just been completed at Arisaig House, for Mr. A. W. Nicholson.

Notices of Removals.—Messrs. North, North & Co. (late George North & Co.), consulting engineers, &c., also George North, M.I.M.E., A.M.I.E.E., &c., have removed from 90, Queen Street, London, E.C., to 61 and 62, Gracechurch Street, London, E.C.

Messrs. B. Verity & Sons, owing to the growth of their electrical engineering business in the Birmingham district, have recently taken large offices at 116, New Street, Birmingham, above the show rooms where their goods are exhibited. Their branch show rooms at Manchester are at 29, Princess Street, facing the Town Hall. All matters connected with their new Electrical Compendium, or dealing with goods factored by the firm, are carried out solely by the Works Department at Aston.

New Books.—Messrs. Whittaker & Co. will issue next week a new work by Mr. Allsop entitled, "Practical Electric Light Fitting," a treatise on the wiring and fitting up of buildings deriving current from central station mains, and the laying down of private installations, including the latest edition of the Phœnix Fire Office rules. The work will be fully illustrated. They expect to have ready also Part 1 of Mr. Maycock's new elementary manual of electric lighting and power distribution, for students preparing for the ordinary grade examination of the City and Guilds of London Institute, and general readers. Copiously illustrated with original diagrams. With questions and ruled pages for notes.

Electric Lighting in Antwerp.—Electric lighting is just beginning in Antwerp. Mr. Inrig has just completed a 65-light installation in a tank steamer, ss. *Oural* (slow speed coupled direct system), belonging to the Société Anonyme pour l'Importation des Huiles de Grassage, Antwerp, and is now lighting the engine works of Messrs. Booth & O'Halloran, Antwerp, with six arc lamps and 30 incandescent lamps of 32 C.P. each. It is to be hoped that others will follow now that a start has been made.

Electric Light in Elgin.—A private electric lighting installation has been erected in the premises of Mr. Gordon R. Shiach, L.D.S., of North Guildry Street, Elgin. This is the first introduction of electric lighting into the town. Mr. Shiach has adopted the Scott-Sisling system, and the work has been carried out by Mr. G. W. Lummis Pattison, electrician to Messrs. R. H. Barnett and Co., of Newcastle-on-Tyne, which firm are the northern agents for the Scott-Sisling system.

The Electric Light at Bristol.—Acting under the advice of Mr. W. H. Preece, the Bristol electrical committee determined to appoint a resident engineer to have charge of the station and installation. A salary of £250 was offered, and between 40 and 50 candidates were forthcoming. After a process of winnowing down had been gone through, some 20 names represented the "survival of the fittest." These, with testimonials, were passed on to Mr Preece, who, after personal interviews with most of the candidates, made a report. The committee, after further consideration, decided to offer the appointment to Mr. Faraday Proctor, who has been second electrical engineer at Newcastle-on-Tyne, where the bulk of the work in connection with the local installation has devolved upon him. Mr. Proctor has accepted the appointment at Bristol.

Tenders Wanted—Belfast.—Tenders are invited for the supply and erection of an electric light installation in their hotel premises, Royal Avenue, Belfast, consisting of two dynamos, and from 500 to 700 lights, with or without additional arc lights, for the Belfast Central Hotel Company, Limited. A copy of the specification will be forwarded on deposit of £3 3s., payable to the directors of the Belfast Central Hotel Company, Limited, which will be returned on receipt of a *bona fide* tender, accompanied by the copy of specification supplied. Plans of the building can be inspected at the offices of the company's architect, Mr. S. Stevenson, 83, Royal Avenue, Belfast. Tenders will be received up to 25th inst. Mr. J. M'Clune, secretary, 20, Rosemary Street, Belfast.

Tenders Wanted—Wolverhampton.—Tenders are invited for constructing works for the supply of electricity to the central portion of the borough, for the corporation. A copy of the specification of the requirements of the corporation (with a plan of the compulsory area to be lighted), will be forwarded on receipt of £2 2s., which sum will be repaid on receipt of a *bona fide* tender. Tenders must be delivered at the office of Mr. Horatio Brevitt, town clerk, Wolverhampton, by 5 p.m. on November 15th, endorsed "Tender for electric lighting."

Strode & Co.—The following is a list of some of the work at present in the hands of Messrs. Strode & Co.:—Electric lighting of Richmond municipal buildings and several private houses; electric lighting of the Stock Exchange after completion of certain extensive alterations; the Metropolitan Insurance Company's offices in Moorgate Street; some very large residential chambers in Dover Street, Piccadilly; offices of the Alliance Assurance Company; offices of Messrs. Slaughter & May, 16 to 18, Austin Friars; offices of the Safe Deposit Company, Great Winchester Street.

Temporary Electric Lighting. — The Weymersch Primary Battery Syndicate recently carried out the temporary lighting at a ball given by Mr. J. Piper of Tufton Place, Northian, Sussex. 40 lamps of 16 C.P. were in use continuously, and Mr. J. Piper has expressed complete satisfaction with all the arrangements, which were carried out under the direction of Mr. E. C. de Segundo, A.M.I.C.E., consulting engineer to the syndicate.

Bridgend and Electric Lighting.—The Bridgend Local Board having, in their investigations regarding the introduction of electric light for the public and private lighting of the town, visited Lynton and other installations, called a special meeting last week and decided to employ the services of a consulting engineer. It was decided to instruct Mr. Morgan Williams of the firm of Messrs. Morgan Williams & King, to advise them in the matter, and at a special meeting on Tuesday last he was in attendance when the Board's proposals were laid before him, in order that he might report on the practicability of the same.

Club Electric Lighting.—The contract for the electric lighting of the Kildare Street Club, Liverpool, for which 450 lights were required, and which was placed with the Manchester and Liverpool Electric Engineering Company, has been completed within five weeks from date of order. These premises have been wired on the three-wire system. The inspecting engineer for the work was Major-General Webber, C.B. This same company has also several private installations in hand in that part of the country.

Electric Light in Mills.—An experiment was recently tried in the Owen O'Cork flax spinning mill, to see if the electric light would be better than the gas, which was of a very bad quality. About half of the premises was illuminated by this means, and the work has been so satisfactorily and efficiently carried out by Mr. George Coombe, electrical engineer, that it has now been decided to extend the lighting through the whole of the mill. There are at present 500 18-C.P. lights in use.

Strode and Company's Patent Slide for Electroliers.—A new patent telescopic slide for electroliers has been just brought out by Messrs. Strode & Co. The following is a description:—Fig. 1 represents the telescope extended. The working parts are contained in a loose cover, A, which is held in position by nut, B. The tubes, C, C, C, telescope, the end being provided with a screwed nipple, D, to which the electric fitting of any design is attached, cable E being connected to the wires in fitting. The current is conveyed by leads, F, F. Fig. 2 shows one side of the working part with loose cover, A, removed, but with the telescope closed. The leads, F, F, are connected to terminals, G, G, on insulated stock, H, which is provided with a fuse which can be easily renewed. Two spring contacts, J, working on two metal rings, K, on the side of insulated drum, L, convey the current to the flexible cable, E. This flexible cable is connected by

suitable terminals on drum, L, as described in fig. 3. The weight of the electric fitting is sustained by a steel band which is wound upon drum, M. This drum contains a spring which can be regulated to the desired weight to be carried. Fig. 3 represents the reverse side of the working parts of the slide to fig. 2, also with cover removed. The flexible cable, E, passes through the telescopic tubes, C, and is wound round the drum, L, in such a manner that when the electrolier is lowered the cable unwinds, and when the electrolier is raised the cable is wound up on the drum, which is provided with a

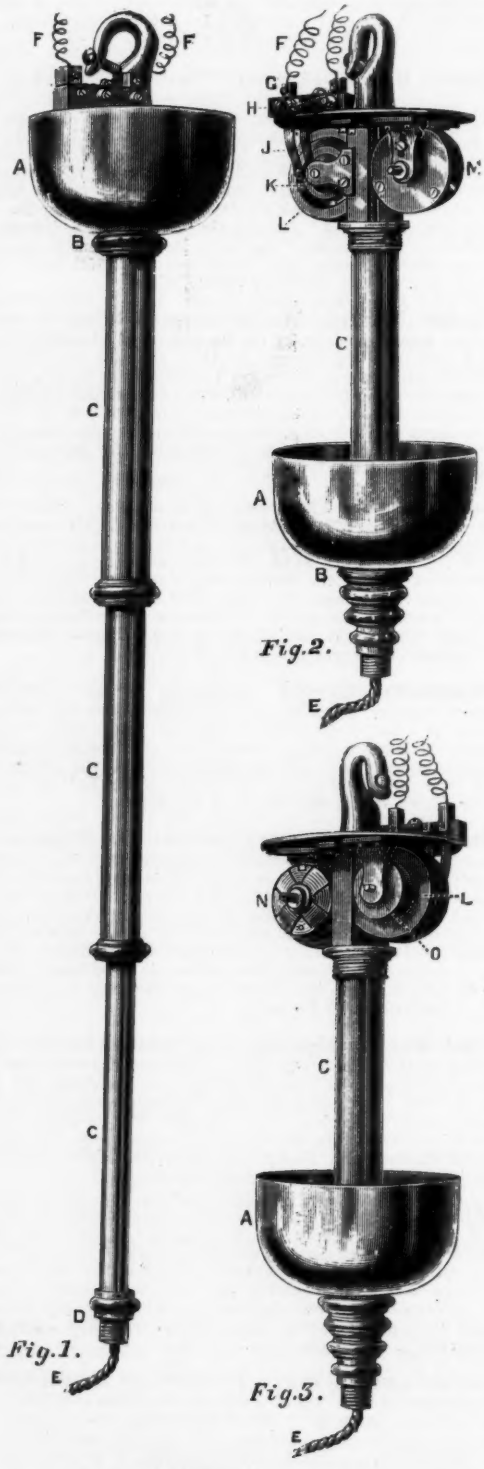


Fig.1.

Fig.2.

Fig.3.

spring contained in a spring box, O. The ends of flexible cable being attached by screws to contact pieces on the metal rings, K (fig. 2). To secure an even tension on the spring which is contained in drum M (fig. 2), a break, N (fig. 3), acting on the side of the drum is provided. This break is regulated by a screwed nut, and secured by a lock-nut acting upon a disc spring. This electric telescope slide is made to carry weights from 3 lbs. to 40 lbs., and can be made to order to any special length or design.

Richmond and Electric Lighting.—At a meeting of the Richmond Town Council, the electric lighting committee reported that, after some delay, the plans of Messrs. Latimer Clark and Co. for the electric lighting works in Richmond had been submitted in detail, and approved by Mr. Shoolbred.

Callender's Bitumen Telegraph and Waterproof Company, Limited.—The directors of Callender's Bitumen Telegraph and Waterproof Company, Limited, have declared an interim dividend at the rate of 8 per cent. per annum on the capital of the company, payable on November 1st next.

Sharp & Kent.—Messrs. Sharp & Kent inform us that Mr. E. Jesse Piper, who since October last has been associated with them in their Holloway central lighting station, has become a member of the firm in the business of engineers and electricians. The name of the firm will remain as hitherto.

W. T. Henley's Telegraph Works Company, Limited.—The contract for the supply of arc light cables for the Glasgow Corporation has been placed with this company.

CITY NOTES.

The Brazilian Submarine Telegraph Company, Limited.

THE thirty-eighth ordinary general meeting of the shareholders of this company was held on Wednesday, 19th inst., at Winchester House, Old Broad Street, E.C., Sir James Anderson (chairman of the company) presiding.

The SECRETARY (Mr. Thomas Fuller) read the notice convening the meeting, also the minutes of the last meeting.

The CHAIRMAN, in moving the adoption of the report, said he presumed they would, take it as read. He would, as usual, make such remarks as appeared to him appropriate. To begin with, he need only refer to some of the leading points in the accounts, and then go on to say with prudence what was in his mind with reference to the competition in which they were engaged, and upon which so much of their future prospects depended. The leading points in the report and accounts were that there was a decrease in revenue of £15,216, as compared with the preceding half-year, mainly due to the low rate of exchange; that was, however, improving, he was glad to say. They had spared no effort to raise their charge of currency to meet this loss upon their sterling recipts, and apparentl, they were working to that end with some hopeful result. There was a decrease of £47,000 in their revenue as compared with the corresponding half-year of 1891, but the revenue of that half-year was due to the state of affairs in the South American Republics, which they had no right to expect would continue, and no right to hope that it would do so. The total expenditure was £2,929 less than the previous half-year. The repairs to cables cost less by £9,633, but they were compelled to increase their staff for the working of their duplex system, and necessarily they were obliged to increase their accommodation for that staff, as there were no houses at St. Vincent. They had also to erect tanks for their spare cable, and extend office accommodation within this half-year at a cost of £1,150. Then there was the cost of applying duplex to No. 2 cable, £3,000 of this cost falling due the half-year under review. The duplex system had been of immense value to their working, and they could, if they thought proper, work both ways on the next cable also, so that they had a large margin of carrying power. That expenditure brought the total decrease of expenditure to £2,929. He would not refer, unless they particularly desired it, to the separate items of increase and decrease. He would refer to such criticisms as had come to hand from three of their proprietors. Out of 2,900 shareholders they had had three letters; naturally they received such criticisms with all respect, and considered amongst themselves whether their policy could be defended upon business principles in the best interests of the proprietors and in the interest of maintaining the property, and the security, so far as it was possible, of their revenue for the purpose of dividends. For several years, he (Sir James Anderson) had warned them that something like a crisis was coming, and now at this moment they were face to face with a rivalry which would test the wisdom of the policy of the board since the formation of the company 19 years ago. One honourable proprietor was of opinion that they ought not to make extensions out of revenue, but add all to capital, and that all such expenditure as could be properly debited to capital account should be so treated. Of course, as a matter of bookkeeping, there was much to be said in support of such a contention; but, if such a policy were adopted in practice, then farewell to quarterly dividends; and when, in the course of time, a large expenditure of capital became imperative, it could only be got upon such onerous terms as would postpone or destroy all prospect of any dividends upon ordinary stock, whereas, with a large reserve, such as they now had, and with a moderate amount of debentures, they could at once lay another cable if they desired to do so. They were in this position: their revenue-earning capacity was secure, even though a tariff war should be forced upon them. They would not willingly initiate it, but they were directly threatened with it, both on the west and on the east coasts. A reduced tariff, however, would, no doubt, increase the traffic, and besides being in a position to carry it better than any other company, if the fight were too hard, they had the interest of their reserve to fall back upon for dividend purposes, if need be, as supplementary to their income from traffic. They were not exactly on their backs if they had a great

opposition, for they had this reserve of interest to fall back on, and they would not have to go without a dividend, even though they dipped into the reserve. They were not so weak, therefore, as their opponents thought—at least, he believed so. The directors had always followed the principle of keeping the capital down, satisfied if they could pay a fair dividend and keep a strong reserve. The other honourable proprietors who had written to them were of opinion that they ought to pay a larger bonus, and they told the directors what they were very conscious of, that the sum carried to reserve was large in proportion to the dividend. That was very true; but they had a property liable to attack, and which was being attacked at the present moment, and in a manner which seemed to leave no alternative short of a war of tariffs. It looked like that at the present moment, but a great deal might happen between just now and by-and-by. They were warned by their rival on the west coast that if they did something—which they certainly would do, and must do—he will reduce the rates; but they were not without resources to meet that threat, if it were to be put into practice. He had, so far, lowered the tariff, and so had they. On a previous occasion he (Sir James) told them they had reduced their tariffs by 33 per cent. and 50 per cent., and they could go as low as any company could, and not be altogether without a dividend. Their rival had a cable from Panama to Valparaiso. A few years ago the Brazilian Submarine Company worked in harmony with a company called the West Coast of America Company, going from Lima and Callao to Iquique, Arica, and those ports down to Valparaiso. For some reason not yet known to them, that gentleman disregarded his partners, and carried his cable down to Valparaiso, leaving the west coast cable out in the cold. It so happened that the Globe Company was largely interested in that cable, and they did not see—and do not yet see—why that cable should be ruined, and they do not intend that it shall be. In order to protect that cable, a company had been formed to lay a land line across the Andes from Valparaiso to connect the west coast of America cable with the east coast cables; so they would have in a few months' time cable communication all the way from London to Lima—from Peru to England and Europe; and their friend threatened them that if they did not let it alone he would do something very dreadful, and come and attack them, as he had done for years. They were making that line, however, across the Andes. It was three parts made already, and, do what he would, they would fight for it, and they would then see what happened. Then there was the company on the east coast—from Senegambia to Pernambuco. That cable had been making for the last two years, and was now opened, or about to be opened, for traffic. The promoters sought to raise money by the avowed and published statement that they would take £80,000 per annum from this company or the joint-purse companies, and they opened their cable at a tariff 4d. per word lower than the tariff agreed upon—as fixed on by the Paris Conference as the obligatory tariff by every route for extra-European traffic. He would explain that. The Telegraph Convention, which met every five years, had agreed that all traffics transitting any part of Europe was certain traffic, and that no company should come in and have a lower tariff, the object of the convention being to create as many ways as possible for telegraphic communication at equal rates—not opposition rates. That was called the European *régime*. For extra-European traffic there was a higher tariff charged over the land lines transitting Europe, because they say, and properly say: "If we have to maintain land lines all through Europe, Russia, Italy, and those great distances—if we have to maintain them for extra-European traffic—necessarily, as there is nothing else going over those lines, we must have a larger tariff." There was, therefore, a European *régime* and an extra-European *régime*, and the convention said that those two tariffs should be common to all comers; but no one was to come in and oppose them with European powers by some accidental line got up for promoting purposes. Therefore, they were leagued together at that conference to establish a tariff fair to all comers. It seemed strange to them that a private company, in disregard of inflicting loss upon every European State, and upon the cable companies more especially, should, without any attempt to negotiate, rush before the public with a reduced tariff, for no reason in the world but to force the Brazilian Submarine Company to make terms that would give a value to their property which it did not now possess, as it was, so to say, a fifth wheel to a coach. He did not wish to say even so much about that cable; but it was due to them that he should say something about a rival that had just come into the field. Its promoters, who were also its proprietors, were not allowed to carry their traffic lower than the convention rates; but they were, he was told, carrying press traffic free—or they were doing so two days ago. They were, as they said, determined to worry them into terms which they hoped would enhance the value of their speculative cable. All he said just now was that they would see. They pretended friendliness—and, personally, they were all friends; but they left no stone unturned to injure them, and it was possible they might tire of carrying even press messages for nothing. At all events, it did not frighten them.

Then there was the Antilles cable, which was owned by a French company, and which went from Guadaloupe down to Para. They hoped to get a concession from Portugal to go to the Azores. That was given to the Brazilian Submarine Company, but through some superior diplomatic action it was taken from them. As he had said, this French company were now trying to obtain from France a subsidy of £80,000, and if they could get that they proposed to carry that cable and join it on to the Antilles cable. He did not know that France was very much inclined to pay that £80,000, and, at all events they had not got it yet. They would observe from what he had said that it was a very costly fight that was now going on; but he ventured to believe that they would approve their policy of paying a moderate dividend and making a strong reserve, equal to a system of offence or defence. They were carrying messages from Buenos Ayres to England within the hour, and from Pernambuco to Rio Janeiro within the half-hour. Commerce could not want greater facilities than that, unless it were that they should carry telegrams free, and that they could not do. They were just now in a position as if a merchant in London had his foreign correspondent in the same building, and they carried on their intercommunication by what some had called a whispering gallery. There was no system of international telegraphy which could beat them, he did not know what science had yet in store for them; but, so far, they did not know that there was anything looming in the distance that could excel what they were now doing, and they could adopt anything that might be proved to be better or faster. Their cables were duplicated and duplexed, their speed of transmission could not be excelled, and they had a substantial reserve, which enabled them to look their rivals in the face, and they certainly need not be under any feeling of panic or alarm. That was the position they were in, and, in his opinion, it was a very sound one. They had laboured at it all along for 19 years, steadily pursuing the policy of building up a reserve fund, and warning them from time to time that this was their backbone, and that while they were paying a good dividend they must be satisfied to let the directors take from the revenue what they could spare to strengthen their position. He looked forward to that with their reserve fund, that if they were in a tight fight they could do two things: they could take the interest on the reserve fund and put it to the reserve, and not add any more to that fund, or they could take it for increasing their dividend, plus any dividend arising from the traffic. He therefore, did not address them in a pessimistic spirit or in a despairing tone. He thought they were in a good, sound position. He then proposed the adoption of the report and accounts, and the payment of the dividend and bonus recommended.

Mr. Frederick Youle seconded the motion.

Dr. Trewhella, whilst supporting the board in setting aside a good reserve fund, thought the directors might take into consideration whether the amount transferred to that fund might be £10,000 or £20,000 a year less.

The Chairman, in reply, urged the proprietors not to press the board on that subject at the present juncture, and pointed out they were as much alive to the importance of the question raised as the shareholders.

The motion was then put and carried unanimously.

On the motion of the Chairman, Sir Henry Gooch, Bart., and the Duke de Loulé (retiring directors) were re-elected.

The Rev. N. Willis proposed the re-appointment of Mr. Henry Dever and Mr. John Gane as auditors of the company.

This was seconded by Mr. W. C. West and carried.

Mr. Griffiths moved a vote of thanks to the chairman and board, also the staff at home and abroad, for the efficient manner in which they had managed the affairs of the company.

Dr. Trewhella seconded the motion, which was agreed to.

The Chairman briefly acknowledged the compliments, and the proceedings terminated.

Société Française des Téléphones Sous-Marins.

Some time since we gave some details of the submarine cable works erected at Calais by the Société Générale des Téléphones, with the assistance of the Société Française des Téléphones Sous-Marins, and now some interesting particulars (furnished by M. Vlasto) are to hand regarding the company's lines. The company was formed in 1888 to take advantage of the landing concessions acquired on different points of the Antilles; it afterwards obtained the privilege of landing in Brazil the lines from America and the Antilles, while this year it has obtained from Portugal the concession of landing in the Azores. By this fact, it now stands tenth in order of importance of the 26 submarine lines belonging to private companies. Its lines extend over a length of 6,952 kilomètres. M. Vlasto, in the course of his remarks, says the following: "Everyone has spoken of the Calais-Dover cable which telephonically connects London and Paris. This cable, laid in 1891, about 18 miles long, does honour to the engineers who conceived it, but it is not, as has been said and repeated, the first submarine telephone cable. The Société Générale des Téléphones, in 1889, laid a cable between Guadaloupe and Marie Galante (length 19·81 miles), which from the first day has worked telephonically, without interruption, between the two islands. This cable, manufactured at the Benzons works, was laid by the Société des Télégraphes Sous-Marins, and it is a priority worthy of being pointed out, the more so as we must not allow the legend to become established that the Calais-Dover cable was the first of the kind." Of course, the patriotic journalist has his say on the subject, which he does as follows:—"The clever initiative of the English, backed up by Government, has assured for 25 years a complete monopoly to the English submarine cable companies. They, in a manner, took possession of the world. But some lacunæ remained, and one can but applaud when he sees a French company profiting by them. The time will doubtless come when the French line from the Antilles will be placed in communication with Europe."

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 16th, 1892, amounted to £902; corresponding month, 1891, £794; increase £108; total receipts to date, 1892, £12,518; corresponding period, 1891, £11,415; increase £1,103.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 14th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, amounted to £3,611.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation October 13th.	Closing Quotation, October 20th.	Business done during week ending October 20th, 1892. Highest.	Lowest.
250,000£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100—103	100 —103	...	...
1,247,720£	Anglo-American Telegraph, Limited	Stock	50 — 51	50 — 51xd	50⅛	49⅜
2,876,140£	Do. do. 6 p. c. Preferred	Stock	91 — 92	90 — 91xd	90¼	89⅞
2,876,140£	Do. do. Deferred	Stock	10⅜— 11¼	11 — 11½	11 5/16	11⅛
130,000	Brazilian Submarine Telegraph, Limited	10	10⅜— 11¼	11 — 11⅛	11½	11⅜
53,200£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3½	3 — 3¼xd	3 3/16	3⅛
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛— 2⅜xd	2 3/16	2⅛
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	3½	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2⅛— 3⅛	2⅛— 3⅛	...	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	10⅛— 11	10⅞— 11⅛	11⅛	10 9/16
$7,716,000	Commercial Cable, Capital Stock	$100	163 —173	168 —173	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	⅛— ⅜	¼— ⅜	5/16	¼
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos 1 to 20,000	5	5 — 5⅛	5 — 5⅛	5⅛	...
16,000	Cuba Telegraph, Limited	10	11⅛— 12⅛	11⅛— 12⅛	12 3/16	...
6,000	Do. do. 10 p. c. Preference	10	17⅛— 18⅛	17⅛— 18⅛	17⅜	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3¼— 3⅜	3 5/16	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅞— 12⅛	11⅞— 12xd	12	11 13/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15 — 15⅛	15 — 15⅛xd	15⅛	15
70,000	Do. 6 p. c. Preference	10	15½— 16	15½— 16xd	16	15⅞
200,000£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 —109	107 —110	108⅞	...
1,200,000£	Do. 4 p. c. Mortgage Debenture Stock	Stock	111 —114	112 —115	114⅜	112
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅜— 15⅝	15⅜— 15⅝xd	16½	15 5/16
70,600£	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	103 —106	...	...
250,200£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	109 —112	109 —112	111½	111
122,400£	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	103 —106	103 —106	103¼	...
163,700£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 —106	103 —106	...	...
300,000£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	103 —106	103 —106	103¼	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	4 — 4⅛	4⅛— 4⅜	4⅜	4 5/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	5/8— ¾	⅝— ¾	1 1/16	...
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	2 — 2⅛	2 — 2⅛	2 1/16	2
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1 — 1½	1 — 1½	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	1 — 2	...	...
180,227	Globe Telegraph and Trust, Limited	10	10⅜— 10⅝	10⅜— 10⅝xd	10⅝	10⅜
180,042	Do. do. 6 p. c. Preference	10	15⅜— 15⅝	15⅜— 15⅝xd	15⅝	15½
150,000	Great Northern Tel. Company of Copenhagen	10	18½— 19	18½— 19	...	...
210,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	105¾	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	5½— 6½	5½— 6½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½— 22½	21½— 22½	22¼	21 15/16
200,000£	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 45	43 — 45	43½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½— 3½	2½— 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 1/16— 3 1/8	3 1/16— 3 1/8	...	...
10,000	Do. do. fully paid	5	5 1/16— 5 3/16	5 1/16— 5 3/16	5⅛	4⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½— 7	6½— 7	...	...
50,000£	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	104 —107	106	...
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅝— 4⅞	4⅝— 5	5	4⅝
15,000	Do. 6 p. c. Cum., 1st Preference	10	13¾— 14¼	14 — 14½	14¼	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½— 14	13⅜— 14	13⅝	13⅜
726,477£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 —113	111 —113	112⅝	111⅜
48,000£	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	1⅝— 1⅞	1⅝— 2	1 15/16	1 11/16
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	4½— 5½	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
10,802	Reuter's Limited	8	7 — 8	7 — 8xd	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7¾— 8¼	7¾— 8	• 8	7¾
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8¼	8 — 8½	8 1/16	...
3,381	Submarine Cables Trust	Cert.	116 —121	118 —122	119½	118
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3½— 4	3½— 4	3⅞	3 13/16
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45¾	44½
150,000£	Do do. do. 5 p. c. Bonds, red. 1894	100	103 —106	103 —106	...	...
58,000	United River Plate Telephone, Limited	5	1⅞— 2¼	2¼— 2⅜	2⅜	2¼
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	90 — 100	90	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½— 7½	6½— 7½	...	...
271,400£	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	...	...
30,000	West Coast of America Telegraph, Limited	10	3 — 4	3 — 4	3¼	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	103 —107	103 —107	...	...
64,242	Western and Brazilian Telegraph, Limited	15	8½— 9	8⅝— 9¼	9⅛	9
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½	6 9/16	6½
33,129	Do. do. do. 5 p. c. Deferred	7½	2½— 3	2½— 3	3	...
184,100£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	105 —108	...	...
230,100£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	105 —108	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅛— 1⅜	1¼— 1½	1½	1⅜
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9½— 10	9⅝— 10¼	10	...
4,669	Do do do. 6 p. c. 2nd Preference ...	10	8½— 9½	8½— 9½	9¼	8½
80,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	103 —106	103 —106	...	...
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	123 —128	123 —128	...	...
171,000£	Do. do. 6 p. c. Sterling Bonds	100	100 —103	100 —103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½— 6	5½— 6	5⅞	5⅝

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. Bank Rate of Discount.—3 per cent. (October 20th, 1892).

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid 7½—7⅝.—Electric and General Investment, shares of £5 (£1 paid), 2⅝—3⅛.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6⅜—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20⅝.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2⅜—3⅛.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5⅛, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅛—5⅜.—Liverpool Electric Supply Shares of £5 (fully paid), 5 1/16—5 3/16.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—⅛.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—⅛.—Do. Debentures, 103—⅛.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅛—¼.—£5 Preference (fully paid), 2⅛—3.

A STUDY OF THE INFLUENCE MACHINE.

By J. E. TAYLOR.

(Concluded from page 460.)

An influence machine may be designed either for obtaining the maximum length of spark, or for evolving a larger quantity of strain at a rather lower difference of potentials. The length of spark depends on the absence of leakages, which may be classed as surface leakages, and leakage by means of glow discharges. In the Wimshurst machine the surface leakages depend on :—

1. The space between the sectors on each plate.
2. The radial distance between the sectors and the boss of the machine.
3. The state as to cleanliness and dryness of all the insulating surfaces.
4. The angles of the neutralising rods from the horizontal. (The best position for these is to make these angles as great as possible, without seriously decreasing the quantity evolved ; this position can easily be ascertained by trial.)
5. Atmospheric conditions, and the hygroscopic properties of the plates.

The leakages by glow discharges depends on all of the above, excepting, perhaps, number 5, and also on :—

6. The quickness or otherwise of curvature of any conducting parts of the machine or conductors near the machine, more especially negatively charged surfaces.
7. The state as to cleanliness of the conductors, especially the discharging knobs, and the amount of dust contained in the air surrounding the machine.
8. The distance round the edges of the plates from one set of sectors to the other, to a slight extent.

The cylinder form of Wimshurst's machine has great advantages in respect of leakages, due to causes 1 and 2 ; but it does not appear that a suitable insulating substance for these cylinders is obtainable ; and for a given length of spark the cost of making a machine of the cylindrical form is probably nearly, if not quite, as great as that of the plate form.

On account of these leakages, which we can, from the nature of the thing, only minimise to a certain extent, the length of spark is also very largely dependent on the quantity evolved ; for a given rate of leakage from a large quantity will have less effect in lowering the difference of potentials than the same rate of leakage from a small quantity. The quantity of strain which a machine is capable of evolving is dependent on :—

1. The leakages.
2. The areas of the generating surfaces of the plates ; or, where the glass surfaces are not brought into action, the size of the sectors.

Both the length of spark which any form of influence machine is capable of giving, and the quantity it is capable of evolving, are dependent to a very great extent on the strength of the dielectric in which it is immersed. This affects both the leakage by glow discharges and the strengths of the electrostatic fields existing between the various parts of the machine. Take, for instance, the field crossing the air space between the plates of a Wimshurst machine where the induction takes place across. The weak air dielectric is not capable of maintaining the powerful strain produced here when the machine is in full work, and on looking between the plates the breakdown, in the shape of numerous glows and sparks, can be plainly seen in a darkened room. The effect of this breakdown is virtually to rid the sectors or glass surfaces, as the case may be, of a large portion of their charge, and so to considerably decrease the output of the machine from what it would be if this breakdown did not take place.

The advantages of the form of Wimshurst machine utilising the glass surfaces as carriers, both in respect of length of spark obtainable and quantity of strain evolved, is evident from the above considerations of leakages.

The consideration of the effect of the strength of the dielectric medium in which the machine is immersed, leads to a new development in the history of the influence machine; that is, to immerse the whole machine in a considerably stronger dielectric, electrodes alone excepted. Some few experiments of this kind have previously been tried, but not with any particular object in view, and without any very great increase of dielectric strength. Thus, W. Hempel, in 1884, found that whereas a Toepler influence machine gave 45 discharges in air at a certain speed of rotation, it gave only nine when surrounded by an atmosphere of hydrogen at the same pressure and with the same speed of rotation. This was due to the weak dielectric strength of hydrogen gas. He also tried increasing the atmospheric pressure of the air in which the machine was immersed, which, of course, has the effect of increasing the dielectric strength, and found that he could get 32 discharges as against 15 in air at the normal pressure in the same time ; while reducing the pressure to about half the normal, caused the action to become so feeble that it died out altogether.* One of the strongest gaseous dielectrics, it may be mentioned, is carbon dioxide. The dying out of the action in the above experiment was, however, no doubt due in great measure to the deposition of moisture from the exhausted air.

The immersion of a Wimshurst form of machine in oil having many times the dielectric strength of air has been tried by the writer with satisfactory results, so far as the experiments have gone up to the present. The machine was, however, one of the form without sectors, and it was found that the glass surfaces could not be brought into action under the oil, and only the small exciting discs could therefore be worked. One or two other defects of a mechanical nature caused the experiments to be deferred for a short time ; the complete results, it is hoped, will be made known shortly. The discharge of the small discs, on reaching the neutralising brushes under the oil, took place with the peculiar detonation accompanying a spark discharge under oil. The oil used was the form of paraffin oil known as "rock oil," it having been found by experiment that of all the forms of paraffin oils (which were chosen on account of their tenuity), it possessed by far the best insulating properties. The method used for comparing the insulating powers of the oils is, perhaps, worthy of note on account of its simplicity. Fig. 22 shows the arrangement adopted.

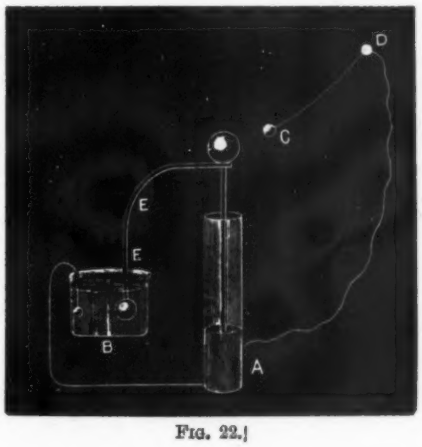


Fig. 22.]

The Leyden jar, A, was charged until the leakage by glow discharges prevented further charge, or until such leakages would rapidly determine its charge when left to recover itself for an instant or two. It was then placed with its upper knob in proximity to a pith ball, suspended from an earth-connected support by means of a semi-conducting cotton thread about 6 inches long, so as to deflect the latter about 45° into the position shown. Then, as the jar lost its charge by leakage (which took about 5 or 10 minutes in air), the attraction would weaken until a critical point was reached, when the ball suddenly dropped to nearly its normal position, and could not be replaced. The samples of oils to be compared are placed in the glass vessel, B, and earth connected by a wire, as shown. The lower suspended knob of the Leyden jar was also immersed, so as to allow a discharge to take place through the oil, as fast as the latter would allow it. The conductor, E, E, was covered with an impervious gutta-percha coating, which prevented surface leakage over the top of the oil. The most conducting kind of cotton thread should be used to suspend the pith ball, as it is found sometimes that when the thread becomes quite warm, it insu-

* *Berichte der Deutsch. Chem. Gesellschaft*, xvii., 145, 1884.

lates the pith ball, and allows its potential to rise, whereupon it will drop. With these precautions, however, the method is very satisfactory for a rough comparison. The insulating properties of the various kinds of paraffin oils turned out to be about inversely proportional to their prices.

Seeing that the Wimshurst machine works more slowly on closed circuit than on open circuit, it might be supposed that a second machine might be used for the sole purpose of assisting the induction taking place in the first machine under the former condition. It would be rather difficult to successfully apply this principle to the usual form of machine, on account of the sectors of the first machine rapidly discharging the machine so used to assist the induction; but there appears to be some likelihood of its being of use in the case of machines without sectors. Fig. 23 shows the arrange-

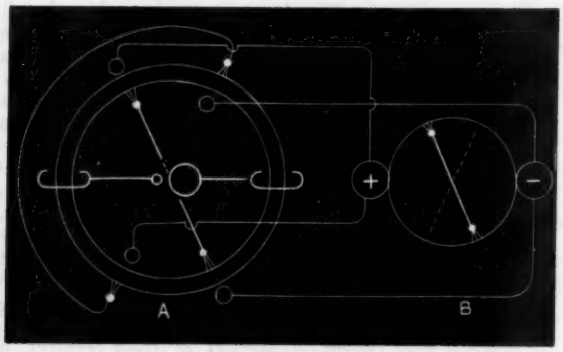


Fig. 23.

ment for so connecting up an auxiliary machine, B. Conductors in connection with the positive and negative sides of the auxiliary machine are led up to the glass plates of the first (A) machine, and terminate in knobs opposite the neutralising brushes. If points were used in the place of these knobs, the auxiliary machine would not be able to develop a sufficiently high potential. In the case of machines having many pairs of plates, the above arrangement might be adopted with some advantage, possibly, by using one of the pairs of plates as the auxiliary machine, and fitting it with separate jars of its own.

It will have been noticed that throughout the diagrams given of influence machines, the positive discharging knob has been shown small in comparison to the negative. By adopting the large negative knob, the discharges (especially in the case of long sparks) are obtained much more regularly and frequently, though less in volume. If the knobs be reversed, only the very shortest spark discharges can be obtained. To get the best effects in air, the positive knob should not be too small, and the negative knob should be many times its diameter. This effect (or other forms of it), in common with a host of other phenomena, have long been regarded as signs of the difference between positive and negative electricities. Some of these phenomena are the following:—

1. Lord Kelvin has found that if a conductor with sharp edges or points is surrounded by another presenting everywhere a smooth surface, a much greater difference of potential can be produced between them when the points and edges are positive than when they are negative.

2. If a piece of cardboard be perforated by a spark between two metal points not exactly opposite, the hole is invariably found to be nearer the negative point, if not exactly under it. But if the experiment be tried under the air pump in a vacuum there is no such displacement of the hole; it is then midway exactly.

3. Prof. J. J. Thomson has proved that in a particular vacuum tube the luminosity accompanying the discharge starts at the positive pole, and travels, approximately, at half the velocity of light.

4. Ultra-violet light can produce a discharge from a negative, but not from a positively-electrified piece of metal.

5. Photographs of "positive" and "negative" discharges show a great difference between the two cases.

With regard to No. 5, it may be remarked that any discharge is, in one sense, just as much a positive discharge as a negative one, and when a difference is observed it is due to the strain having to *converge* towards the positive or negative electrode, as the case may be. Also, with regard to No. 3, the experiment simply proves that the strain commences to break down at the positive electrode with a particular dielectric and conditions, and that this breakdown follows along the tube, wedge action, at about half the velocity of light. Had some other dielectric been used in the tube it would probably have been found to alter something.

All the above phenomena probably have one primary cause in common, that being the molecular structure of the dielectric and the atomic strains in the ether corresponding to any given molecular structure or arrangement, which many phenomena, chemical and electrical, point to as highly probable, and entirely consistent with our ideas of the relations between ether and matter. If this fact be the base of the correct explanation, it is highly probable that the phenomena, as explained above, are dielectric effects, and will vary with varying dielectrics.

In No. 2, at least, the effect on making a change in the dielectric is seen, and, moreover, the writer has found that in the case of the perforation of glass with a little salad oil spread round the electrodes the effect is reversed, and the puncture takes place nearer, or directly under, the *positive* electrode.

In the puncture of glass or cardboard, especially the latter, the explosive character of the discharge is plainly seen. In one case the oil used is blown all over the glass, and pieces of glass dislodged at one side particularly, and in the other case the well-known double burr is produced, due to the same cause.

The form of Wimshurst with extended neutralising rods and minus the usual sectors, when worked in a dark room presents a pretty and instructive sight. The whole machine is bathed in a luminous discharge, the long streaming brushes on the negative side exhibiting a great difference from the short positive glows. This difference is due to the same cause which makes the difference in the discharges when a larger negative or a larger positive knob is used, as explained above. On one side of the machine we have the large flat surface of the plate negatively charged, and the points and edges of the collectors and neutralising rods positive, these conditions being reversed on the other side, or half of the machine. That is, on the former half the strain converges towards the positive, and gives a long, well-formed brush discharge, whilst, on the latter, it converges towards the negative, giving a short glow discharge from thence. Opposite, and on the portions of the plates between the back and front neutralising rods, numerous bright specks are seen; these are the end views of the discharges, due to the breakdown of the strain in the air between the two plates. The effect of the undischarged portions of the plates, when the discharging knobs are brought into action, is also plainly seen; and on the positive side a luminous arc is formed on the plates, due to the undischarged part discharging into the discharged part of the glass surfaces. This effect is not noticeable on the negative side. With large jars on the machine, long brushes are occasionally obtained from the collectors on the positive side, when the jars are very highly charged; such brush discharges indicate leakage from the jars where they are formed.

It should have been mentioned, in discussing the theory of the Wimshurst machine, that so long as the neutralising brushes are joined up positive to negative, it is immaterial (excepting for self-excitement) which particular brush is joined to any other one. Thus the two top brushes, back and front, may be connected, and the two bottom ones likewise. A machine will work feebly, and even excite itself, when all the brushes are insulated, excepting for a mahogany connection offering a very great resistance.

A peculiar form of Wimshurst's machine was constructed by Mr. T. Gray, consisting of the two ordinary revolving plates or armatures, with a third fixed glass plate placed between them. He found that this caused the machine to reverse its action at every few turns of the handle. This experiment may be tried on an ordinary machine in a simpler way, by merely inserting between the revolving plates, at top and bottom, two pieces of glass plate. These two pieces of plate are thus placed in the electrostatic field existing between the back and front discs; in the position, in fact, where the breakdown of strain occurs. This arrangement has the same effect as the former, and the reason

is not far to seek. The breakdown still occurs in the two air spaces on either side of these plates, though, of course, not in the plates themselves ; consequently a strong field is formed inside these glass pieces from surface to surface. When this field has risen to a maximum it will prevent further induction taking place across the air spaces between the two armatures, as, of course, it will take a more powerful field than that already existing in the inserted glass pieces to force more lines of strain through them. This stops the action of the machine, and then the charged glass pieces set up a reverse field on their own account, which re-excites the machine, but in the opposite direction, after which the action goes on repeating itself. Such a machine constitutes an alternate current influence machine, or electrostatic alternator, of exceedingly slow periodicity.

Electrostatic alternators form a branch of this subject in which very little has been done, and in which a great deal more can probably be achieved. The principle of such machines is shown by the diagram (fig. 24).

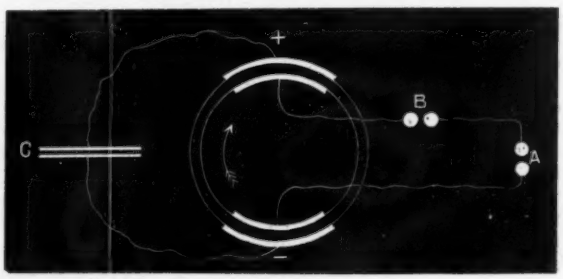


Fig. 24

On a fixed glass plate two field plates of tinfoil are pasted. These are put in connection, respectively, with the two coatings of a charged Leyden jar of *large capacity*, and act inductively on two similar plates pasted on a revolving glass plate. A conductor, connecting these two tinfoil patches or sectors, will have alternate currents induced in it, one of which occur at every half revolution. These currents would not produce any appreciable effect, unless an air gap be made in some part of the conductor, when of course at every half revolution of the glass plate or armature a discharge will take place across the air gap. In the diagram the knobs at A are supposed to represent the usual discharging knobs of any machine, and those at B the air gap. Generally, the discharging knobs, A, would serve both purposes, but in certain experiments those at B would be useful. The condenser, C, should be of sufficiently large capacity to prevent any abrupt rise and fall of the potentials of the inducing plates, which would be the case if this condenser were not joined up. Such rises of potential would necessitate a much lower average potential difference between the two inducing plates, and would also increase the leakage therefrom to a very great extent. An auxiliary continuous current influence machine should also be used to compensate for the leakage which cannot be avoided, and which discharges the condenser. This machine should of course be joined up to the condenser, and both together may, in fact, take the form of a machine supplied with two large Leyden jars joined as is usual, in series or "cascade." Machines involving this principle have been described by Mr. T. H. Muras in the Electrical Review,* but were apparently rather weak in the matter of capacity of the condenser, C. With improvements in this respect, much better results may be expected.

The external circuit of an influence machine, that is, the circuit connecting the outside coatings of the two jars, is a source of many peculiar phenomena. If it be not closed whilst the discharging knobs are separated by a few inches, so that a rapid strong brush discharge takes place there, strong glows and brushes may be seen, in a darkened room, issuing from various parts of the circuit, and a smart shock may be obtained by touching any conductors in this disconnected circuit with one hand only. This is on account of setting up, thereabouts, of an *oscillating* electrostatic field, which is done in the following manner :—

Each time that a discharge takes place between the discharging knobs, the potentials of the inside coatings of the jars are reduced to zero, without discharging them, causing that of the outside coatings to rise suddenly, positively and negatively respectively. The continued action of the machine very quickly raises the potentials of the inside coatings again, at the same time lowering the outside potentials, and another brush discharge taking place between the knobs, the action is repeated, and so on. We have thus a rapid rise and fall of the potential difference between the two outside coatings. The electrostatic field set up between these coatings thus partakes of some of the properties of an alternating field. An insulated sphere, for instance, will receive a stream of sparks from any conductor in connection with these coatings. To get the strongest shocks when touching a wire in connection with one coating, it is only necessary to connect the other coating to a conducting body of fairly large capacity. That we do not in this way obtain a true alternating field, is shown by the difference between the positive and negative glows in air.

If the conductors in connection with the outside coatings be brought within striking distance of each other, a complete discharge of the jars, of course, takes place ; and the discharge in the external circuit is then what Dr. Lodge has denominated an "impulsive rush" discharge, a form of discharge much more convenient and readily available for many purposes than that direct from the inside coatings of the jars. It is for this reason that the diagram, fig. 21, shows a couple of terminals inserted in the external circuit.

A Correction.—The lines of strain in the diagram of the action of the Wimshurst machine (fig. 20) in last week's issue, were not numerically correct. The correct diagram is given below.

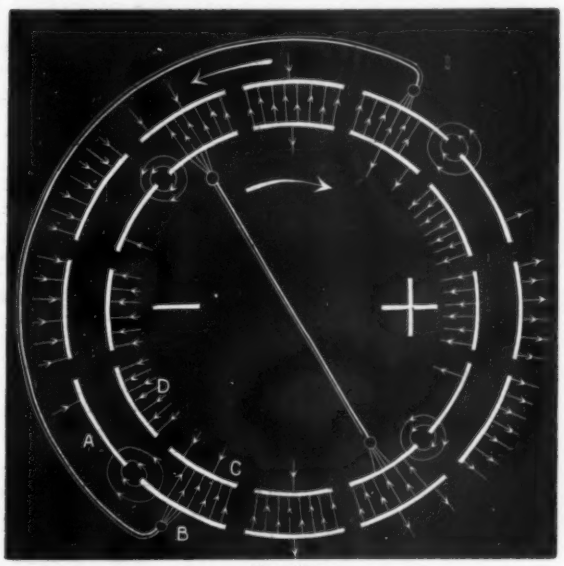


Fig. 20.

TEST OF A STANLEY 17,500-WATT TRANSFORMER.

The *Electrical Engineer*, of New York, recently published an interesting test of a Stanley transformer made at the Cornell University by Prof. Harris J. Ryan. The power dissipated through hysteresis, eddy currents, &c., was determined by the contact maker, condenser and electrometer method already described by us.

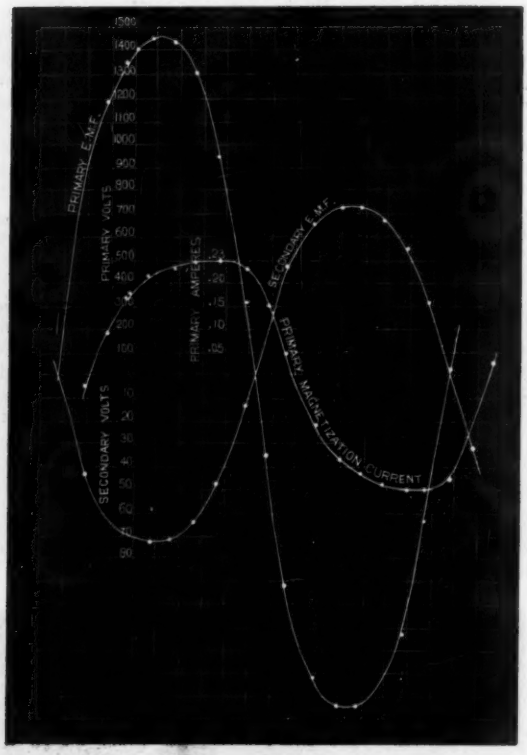
The curves traced in the accompanying diagram show the primary E.M.F. and current and secondary pressure with the transformer on open circuit. The lag is seen to be about 25°. The drop in pressure at full load was about 1·16 volts or 2·32 per cent. And the efficiencies at full load, half, quarter and one-eighth load were severally 96·9, 97·1, 96·0 and 93·0 per cent. For one 16 C.P. lamp the efficiency was about

* Electrical Review, June 17th, 1892.

24 per cent. The all-day efficiency, with the primary pressure continually maintained, and an assumed working output

TEST OF A 17,500-WATT TRANSFORMER, BUILT BY THE STANLEY MANUFACTURING COMPANY.

Primary E.M.F., 1,000 volts.
Secondary E.M.F., 50 volts.
Frequency, 133 periods per second.



Secondary on Open Circuit.

Primary effective E.M.F., 1,110 volts.
Secondary effective E.M.F., 56 volts.
Effective magnetising current, ·195 ampères.
Power lost through hysteresis and eddy currents, 126 watts.

Regulations.—Drop in pressure from no load to full load, 2·3 per cent.
Efficiency at full load, 96·9 per cent.
" " half load, 97·1 per cent.
" " quarter load, 96·0 per cent.
" " one-eighth load, 93·0 per cent.

equivalent to 17,500 watts for five hours out of every twenty-four, would average 93·8 per cent.

The data of the transformer are given on the diagram.

THE ELECTRIC LIGHTING OF GRAZ.

[FROM OUR OWN CORRESPONDENT.]

IT is a peculiar misfortune of most Austrian-Hungarian towns which have gasworks, that in spite of the most earnest endeavours to effect the introduction of electric lighting they either do not succeed at all in realising their purpose, or only after long and difficult labours. In some cities the municipality has by the unfortunate or incautious wording of gas agreements, rendered the introduction of the electric light for many years altogether impossible. In other towns they allow themselves to be terrorised by the gas companies under the threat of law suits, so as to abstain from granting concessions for electric lighting.

Thus the Bohemian town, Teplitz, has submitted to an unfavourable compromise with the gas company, as the latter claimed the exclusive privilege of the use of public territories for laying down conductive pipes for the purpose of illumination, and now includes electric leads in the category of pipes.

The gas company of Fiume by means of an equally frivolous pretext, has for some years rendered it impossible for the International Electrical Company to carry out its concession, as it threatens the city with a suit, into which the latter does not feel free to enter, though every lawyer is convinced that the gas company "has not a leg to stand on."

In the provincial capital, Graz, the firm, Siemens and Halske, have for years held a concession for the erection of electrical works. But here also the gas company have contrived to prevent the project from being carried out. In the meantime the concesson has expired and the town has invited new tenders for the erection of electrical and compressed air works. In the accompanying schedule of conditions, the concessionary is bound to carry out the process with which the town is threatened, at his own expense and risk. Hence the undertaker buys a lawsuit as part of his bargain. The conditions run as follows :—

General Conditions of Tenders for the Erection of a Central for the Supply of Light and Power at Graz.

1. The undertaker of a central for light and power will, until October 1st, 1912, have the exclusive right to supply electricity for lighting and transmitting power by cable leads laid in the streets in the urban territory of Graz, for which he is bound to supply the community and private consumers in those streets which are traversed by cable leads, and in which they may be laid down in accordance with the agreement, at such prices and under such conditions as may be determined.

Every person is, however, entitled to generate electric current for his own use and to convey it elsewhere, but without making use of public lands.

The right of supplying gas or water from the mains of the Graz Gas and Water Company, for propelling motors, will not be in any manner infringed upon. In like manner the Graz Tramway Company is entitled (if the traction of tramcars is permitted by the local authorities) to generate its motive power in any manner, and to convey it along their lines.

The undertaker has therefore to take into account the existing agreements, *i.e.*, the gas agreement of February 21st, 1873, and the water agreement of September, 1870, and February 4th, 1870, and the tramway agreements of 1878 and 1880, and to bind himself not to encroach upon the stipulated rights of these companies, especially in laying down the cables.

2. The community of Graz gives no guarantee in case the undertaker is interfered with or prevented in carrying out his rights by litigation on the part of the gas company. The municipality is not bound to indemnify the holder of the concession in case of any delays or losses incident upon such litigation. In case, however, a decision of the courts absolutely prevents the execution of the undertaking, the holder of the concession is released from all other responsibilities.

Similar conditions devolve upon any person agreeing to supply compressed air, in as far as it may subserve the production of electric light and power.

PROF. MARIE-DAVY DESCRIBES THE REVERSIBILITY OF THE DYNAMO-ELECTRIC MACHINE IN A FRENCH PATENT OF THE YEAR 1854.

BY A. M. TANNER.

THE writer has already called attention in the ELECTRICAL REVIEW to early published descriptions disclosing the reversibility of dynamo or magneto-electric machines. The experiments of Jacobi and Sinsted in the early fifties should be sufficient to show that Pacinnotti cannot be considered as having invented more than the ring armature and mode of commutation subsequently reinvented by Gramme. This honour is sufficiently great, and Mr. F. L. Pope errs when, in recent articles in the ELECTRICAL REVIEW, he attributes the discovery of the reversibility of the dynamo-electric machine to Pacinnotti.

There is, however, another instance positively describing the reversibility of the dynamo-electric machine, before the year 1858, which is the date assigned to Pacinnotti, it is the French patent of Prof. Marie-Davy, of Montpellier, France, dated May 11th, 1854. This patent relates to electro-magnetic machines or motors of various forms, all possessing, however, fixed and movable rings of electro-magnets. Obviously this is not the Pacinnotti construc-

tion; but as the question of the construction of the machine has nothing to do with the broad feature of the discovery of the reversibility thereof, it is only necessary to give the following translation of a portion of the specification of the Marie-Davy patent, in order that historical justice may be done, and honour bestowed to whom *honour* is *due*.

Translation.

"By replacing the soft iron pieces in the fixed electro-magnets with pieces of steel or hardened and magnetised cast-iron, and causing the soft iron cylinders to roll on these magnets, electric currents are produced in the copper wires which cover the magnets. The machine which, under the influence of an electric current furnished by a battery, was a motor applicable to industrial purposes, then became, on the contrary, under the influence of an exterior motor, a powerful, economical, and eminently industrial source of electricity."

NEW PATENTS—1892.

17,563. "An improved detachable electric lamp jointing for removable lamps for shop fronts and similar situations." W. R. WYNNE. Dated October 3rd. (*Complete.*)

17,605. "A new or improved automatic electric switch." F. HARRISON. Dated October 3rd.

17,612. "A new or improved apparatus for stamping telegraphic forms and other papers or deeds." F. P. SLAVIN. Dated October 4th.

17,643. "Improvements in electric switches." H. EDMUNDS. Dated October 4th.

17,647. "Improvements in magneto-electric appliances." H. HYLTON-FOSTER. Dated October 4th. (*Complete*).

17,653. "An improved process for treating cups, separating partitions or diaphragms, used in electric batteries or electrolytic apparatus." A. J. LEHMAN. Dated October 4th.

17,691. "Apparatus for the cutting of glass by electricity." L. HAVAUX. Dated October 4th.

17,698. "A new or improved polarised electrical indicator." H. F. LEWIS and H. H. ELEY. Dated October 5th.

17,700. "An improvement in electric arc lamps." E. C. RUSSELL. Dated October 5th.

17,717. "Improvements in connection with electrical machines and coin-freed mechanism therefor." H. J. AVERY and E. MORAND. Dated October 5th.

17,718. "Improvements in or relating to electrical and mechanical telephone receivers." H. ROSE. Dated October 5th.

17,739. "Improvements in treating or preparing gutta-percha and rubber for various purposes." R. HUTCHISON. Dated October 5th.

17,743. "Improvements in arc electric lamps." E. DE PASS. (Communicated by L. Bardon, France.) Dated October 5th. (*Complete.*)

17,751. "A door lock switch for electric lights." G. F. REDFERN. (Communicated by C. Green, Canada.) Dated October 5th. (*Complete.*)

17,774. "Improvements in dynamo-electric machines, and in their application to secondary battery installations." E. W. COWAN and W. P. J. FAWCUS. Dated October 6th. (*Complete.*)

17,826. "A method of transforming alternating electric currents of any tension into continuous currents also of any tension, and conversely, and apparatus for that purpose." M. HUTIN and M. LEBLANC. Dated October 6th.

17,855. "Improvements in electrical distribution." T. TOMLINSON. Dated October 6th.

17,877. "Improvements in regulators for dynamo-electric machines." T. R. ANDREWS and T. PREECE. Dated October 7th.

17,878. "Improvements in the method of and apparatus for starting electric motors." T. R. ANDREWS and T. PREECE. Dated October 7th.

17,895. "Improvements in apparatus for the manufacture electrolytically, of tubes and other articles of circular section." F. E. ELMORE. Dated October 7th.

17,909. "Electric switches." C. E. CHALLIS. Dated October 7th.

17,922. "Improvements in secondary batteries." F. KING and E. CLARK. Dated October 7th.

17,930. "Improvements in secondary batteries." J. HIRSHFELD, W. MORISON, A. P. MORISON, and W. WRIGHT. Dated October 7th.

17,931. "Improvements in battery compounds." J. HIRSHFELD, W. MORISON, A. P. MORISON, and W. WRIGHT. Dated October 7th.

17,973. "Improvements in electrolytic tanks." J. C. RICHARDSON. Dated October 8th.

17,974. "Improvements in plating metallic surfaces and also prepared surfaces of non-conducting substances by electro-chemical deposition." P. MARINO. Dated October 8th.

17,982. "Improvements in brushes for electric current generating and receiving machines." A. J. BOULT. (Communicated by L. Boudreaux, France.) Dated October 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

5,131. "Means for applying electricity through jets, streams, or sprays of fluids and vapours for therapeutic and other purposes." H. N. LAWRENCE. Dated March 23rd. Consists in providing apparatus and machinery suitable for applying to the body, or portion thereof, water, medicated fluids, steam and other vapours or any fluid or semi-fluid conductors of electricity with electrical conductors and electrodes in such a manner that currents of electricity may pass through jets, streams or sprays of such fluid or gaseous conductors, and be thereby brought to influence the body electrically either by including the body, or portion thereof, in the circuit so formed or otherwise. 5 claims.

5,329. "Improvements in portable electric safety lamps." L. BRISTOL. Dated March 25th. The inventor uses for the outer casing steel, brass, or other suitable metal, and he forms a flange round the top of same to which he fixes by screws the top cover, which when the lamp is on the side of the casing is also of steel, brass, or other metal. Upon the cover is fixed the handle, swivelling or rigid, and in the cover he forms an opening with a vertical rim, through which opening the vent hole tubes from the battery lid are brought up and fitted with gas plugs, the whole being enclosed and protected by a swivelling cover plate. Internally, he has a space between each side of the battery and the outer casing, which he fills with moderately compressed asbestos, cotton wool, or other suitable yielding material. Between the battery and the metal casing on the front side he interposes a wood plate with grooves on its inner sides, through which the wires from the battery are led, and pass through holes in the casing to the circuit arrangements. 4 claims.

5,341. "Improvements in electrical transformers." A. POLESCHKO. Dated March 25th. Relates to an arrangement of the apparatus such that the magnetic flux which circulates in an iron core shall pass in its totality across the secondary coil. 3 claims.

5,350. "Mounting electrical dynamo machines or motors to enable them to be easily reversed for driving in alternate directions." R. R. HARPER. Dated March 25th. The inventor pivots or mounts the dynamo or motor with its support upon a bed-plate or foundation, so that it can be slewed round, end for end, for effecting a reverse rotation, without altering the direction of travel of the driving belt, and this he accomplishes by arranging the axis or pivot directly under the wheel of the dynamo or motor on which the belt acts. 2 claims.

5,406. "Improvements in attachments for telegraph poles for carrying insulators." H. C. JOBSON. Dated March 26th. The inventor employs an attachment for telegraph poles for carrying insulators consisting of an arm made of steel or iron, or other suitable metal, having preferably the figure in cross section of channel or trough iron; that is, the said attachment or arm consists of a flat or buckled back, having parallel horizontal projecting sides or flanges, to which sides or flanges the insulators are attached. 3 claims.

5,485. "Improvements in the means for telephonic communication." E. MASSIN. Dated March 28th. According to one arrangement the two receiving instruments and the secondary circuit of the induction coil are connected at one end to the line wire, or to one of the line wires, the second wire, or the earth contact, being connected to the fixed part of a contact key, which in the position of rest closes the circuit of the two receivers, but which when pressed upon introduces the secondary circuit of the induction coil into the line under exclusion of the receivers. 2 claims.

6,232. "Improvements in microphones for telephonic circuits, and in the induction coils thereof." E. GWOSDEFF and A. BUNGE. Dated April 11th. Claims:—1. The use in microphones for telephonic circuits of diaphragms, the vibrating fibres of which are connected together by means of transverse plates, the microphonic contact pieces being exclusively attached to the said transverse plates, substantially as described. 2. In telephonic circuits, arranging the induction coils in such manner that the transformation of the current is effected simultaneously in two precisely similar coils, the inducing current being made to divide into the two primary coils of the apparatus, and the closing of the circuit or strengthening of the current in one of the branches being made to coincide with the interruption of the circuit or the weakening of the current in the other branch, substantially as and for the purposes described.

10,307. "Improvements in and relating to dynamo-electric machines and electric motors." C. COERPER. Dated June 17th. Consists in allowing the armature coils to remain stationary, and rotating the armature core, the latter having a form and arrangement adapted for the purpose. 9 claims.

12,824. "An improvement connected with electric lighting apparatus." G. ZANNI. Dated July 28th. Has for object, the lighting of incandescent electric lamps from a secondary battery, charged primarily, and afterwards fed to compensate for leakage from a magneto, a dynamo, or other like agent actuated by an electric motor, or by clockwork, springs, or other contrivance suitable for the purpose of giving rotation. 1 claim.

13,705. "An improved coupling for connecting electric wires." A. SHIELS. Dated August 14th. The coupling consists of two parts or sockets, each part consisting of a piece of wood or other suitable material. In each part is fitted a piston or plunger, to which the electric wires are attached, or through which they run. At the ends of the wires contact pieces or armatures are fitted, and they are, preferably, so tapered that, when the two parts of the coupling are brought together, they interlock. The pistons are pressed, normally,

outwards by springs, and they are prevented from turning in the wooden sockets or cylinders by guides, or a guide pin working in grooves. To clamp the parts of the coupling tightly together, one or more pieces of twisted metal, or hooks, is, or are so fitted on each part, that when the parts are brought together, they can be made to catch into one another and grip firmly. When the parts are clamped together, the terminals of the wires are held in close contact by the pressure of the springs, so that the electric current can pass freely.

19,233. "Improvements in and relating to electric railways." J. F. Munsie. Dated November 6th. In carrying out the invention, the inventor establishes, preferably in the space between adjacent track-ways, and below the surface of the road-bed, an underground conduit for the reception of electric conductors, and particularly for the reception of the main line conductors carrying the car-motor current. At regular intervals along the line of the track-ways, the underground conduit opens into wells or man-holes, extending transversely to about the centre of the track-way, at which points supporting posts are located, surmounted by contacts adapted to be electrically connected to the main line wires of the underground conduit, and said contacts are stationed in front of the open ends of slotted guards or casings, extending from one well or man-hole to the next in the series, the said guards being firmly supported by the track-way sleepers. 17 claims.

20,367. "Improvements in couplings for electric wires." A. Shiels. Dated November 24th. To enable the coupling to open automatically, each part is made with a bent connecting arm or extension. The arms or extensions may be made one with or secured to the parts of the coupling. The connecting hose pipes or tubes are fitted on the extensions or arms of the coupling. With this arrangement immediately a horizontal pull or tension comes on the coupling, it will automatically uncouple. 2 claims.

20,933. "Improvements in and relating to electrically propelled hose carts or carriages." M. W. Dewey. Dated December 1st. Consists chiefly in the combination of a wheeled vehicle having two axles and a frame, a hose reel mounted upon the frame, and an electric motor (worked by a secondary battery) supported upon the vehicle and connected with the reel to revolve the same. 11 claims.

20,936. "Improvements in electric heating apparatus." M. W. Dewey. Dated December 1st. Consists, chiefly, in the combination of a plurality of metallic corrugated roughened cases, an electric heat-developing conductor or resistance within each of said cases, and provided with a heat-retaining medium, a frame to hold or support said cases parallel with each other, and separated to allow air spaces between, a supply circuit connected with the heat-developing conductors, and a switch or current controller mounted on the frame to control the current flowing through the resistances, or to include any number of resistances in circuit. 10 claims.

CORRESPONDENCE.

The Conditions and Requirements of a Practical Conduit Trolley System.

In your last issue, under this heading, you refer to a system designed by Mr. R. J. Hewitt, and mention the salient points of his invention, which, summarised, appear to be as follows :—

(*a*) A concrete conduit supported by iron or steel yokes.

(*b*) Man-holes placed at each insulator for the removal of dust and dirt.

(*c*) The use of a flexible conductor so as to reduce the number of insulators.

(*d*) Facilities for transferring a car from a "conduit" conductor to "an overhead."

All these points are *amongst* the features of the system which bears our name, and which has already been described and illustrated in your Journal.

We are pleased to note that, in your opinion, "if these points be attended to it seems that the success attained with the overhead systems would be also realised with the slot rail;" but we think it is unnecessary "to await the details of Mr. Hewitt's scheme," when all the details have been already fully worked out by

Waller & Manville.

October 17th, 1892.

Water Wheels.

In reply to the letter from "Ajax," which appeared in your last issue, may I say a few words about the usual practice in erecting Poncélet water-wheels? These wheels, which are not adapted to falls over 6 feet, are built from 10 feet to 20 feet in diameter, and, in general, from four to six times the head in diameter. The object in making the diameter large is not to increase the gross power of the wheel, but to bring the speed within convenient limits, and to prevent the spilling of water over the top of the vanes. Increasing the diameter increases the torque exerted by the water, but it reduces the angular velocity in the same proportion, keeping the power constant. Owing, however, to the more efficient action with large diameters, the power with these is slightly greater than with small wheels. If the diameter is made *too* large the wheel becomes expensive and heavy, and losses due to friction at bearings will destroy the advantages arising from the increased size. In the particular case cited by "Ajax," there would be some difficulty in designing and fixing the wheel, owing to the heavy backing-up in the tail in winter. Much would depend on whether the power is wanted more in winter than in summer, for the Poncélet wheel could not be constructed to work efficiently under both conditions. A wheel that would work fairly well under both conditions would be erected as follows :—Assuming an average working fall of 4 feet, the diameter should be about 16 feet, and the lowest point in the wheel should be placed so that there would be a drop from the vanes to the tail water of about 9 inches in summer, and a backing-up over the vanes of an equal amount in winter. If required to give the most power in summer, the diameter of the wheel should be 20 feet, and the setting should be such that the water passed easily from the vanes into the tail race. It is difficult to make a final decision with the data supplied by "Ajax;" but, with further information as to the nature of the work required at the mill, I should be happy to go into more detail. But, would not "Ajax" rather put in a low-brest wheel, or, better still, a low-pressure turbine with a suction pipe?

E. Tremlett Carter.

Will the writer of these interesting articles give us some well authenticated tests of work done by water-wheels, compared with head and volume of water. Their useful effect is, I believe, vastly over-rated, being subject to no accurate measurements, beyond the notch or weir, which is only rough guesswork.

A. W. Steavenson.

October 15th, 1892.

Magnetism and "Magnetism."

Your correspondent who, in your issue of October 7th, criticises the criticisms of four theosophists, and accuses them of juggling with words in applying the word *magnetism* to the inductive action of one human body on another, should remember, in that connection, that the word is time honoured, alike among the learned and the unlearned. It is no more misleading than the word ether, used equally for ethylic oxide and the interstellar atmosphere. Moreover, it would not be difficult to make out a case for the parallelism, to an extent, of human and ordinary physical magnetism. Surely even a theosophist may avail himself of a theory upon which to conduct his experiments.

Herbert Coryn.

Although every point in "Harry Austin's" letter has been anticipated in my previous communication, he still persists. Is he irresponsible or merely impressible? In spite of the old proverb, *Interdum stultus bene loquitur*, I do not discern grounds for expectation that any advantage will accrue from taking this correspondent seriously, save perhaps *ad Kalendas Græcas;* moreover, the "F. T. S.'s" and the like have surely had enough advertisement already. And does not "Harry Austin" imply that I am incapable of contributing usefully anything further to the controversy which you have so indulgently admitted to your pages? So I present him with the gratification of having the last word if he chooses.

The Writer of the Leaderettes.

A correspondent asks :—Can you inform me of the number of installations existing in the United Kingdom using *arc* lamps, and where they are situated?

It is rather difficult to give off-hand the number of installations using arc lamps. Our table, published on February 8th of this year, shows fairly what has been done in public stations, but there are many private installations at railway and goods stations and docks where large numbers of arc lamps are used.—Eds. Elec. Rev.